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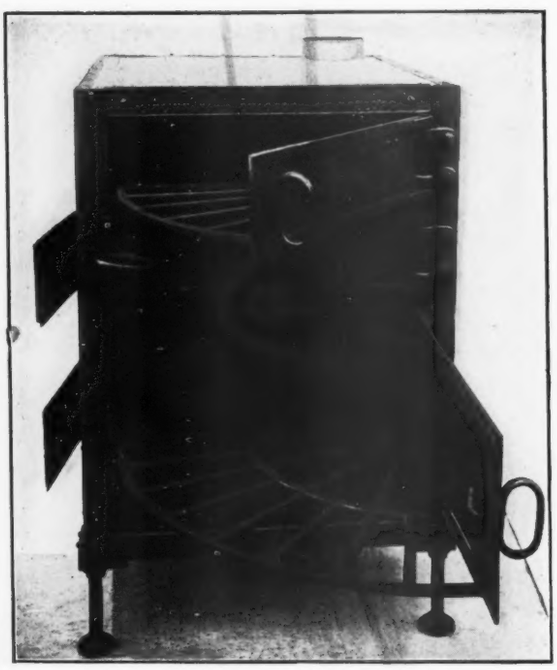

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Height (without legs) - - -	36½ inches
Width - - - - - - - - -	29½ inches
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THE FOUNDRY

Vol. 33, No. 6 CLEVELAND, OHIO, FEBRUARY, 1909 Whole No. 198

MOLDING MACHINES FOR LARGE WORK

Interesting practice at the plant of the Buckeye Engine Co., Salem, O., where molds weighing 10,000 pounds and over are rammed on jarring machines

WHILE THE production of machine-made molds for small and medium work has reached a high state of development, corresponding progress has not been made on large and heavy work, although many machines of various types have been designed for this purpose. This is partly due to the reluctance of foundrymen to withstand possible losses during the experimental stage, which would necessarily increase in proportion to the weight of the castings. Adequate equipment for molding large floor jobs on machines is another drawback which has, to some extent, retarded their use on large work. Yet shops provided with modern conveying and handling machinery can use molding machines to advantage on large floor jobs.

This problem has, however, been successfully solved at the plant of the Buckeye Engine Co., Salem, O., where flasks weighing 10,000 pounds and over are rammed on jarring machines. Molds for large gas engine beds and cylinders are made in this way and the average cost of floor work has been reduced 60 per cent. Hardly a year has elapsed since the first machine was installed,

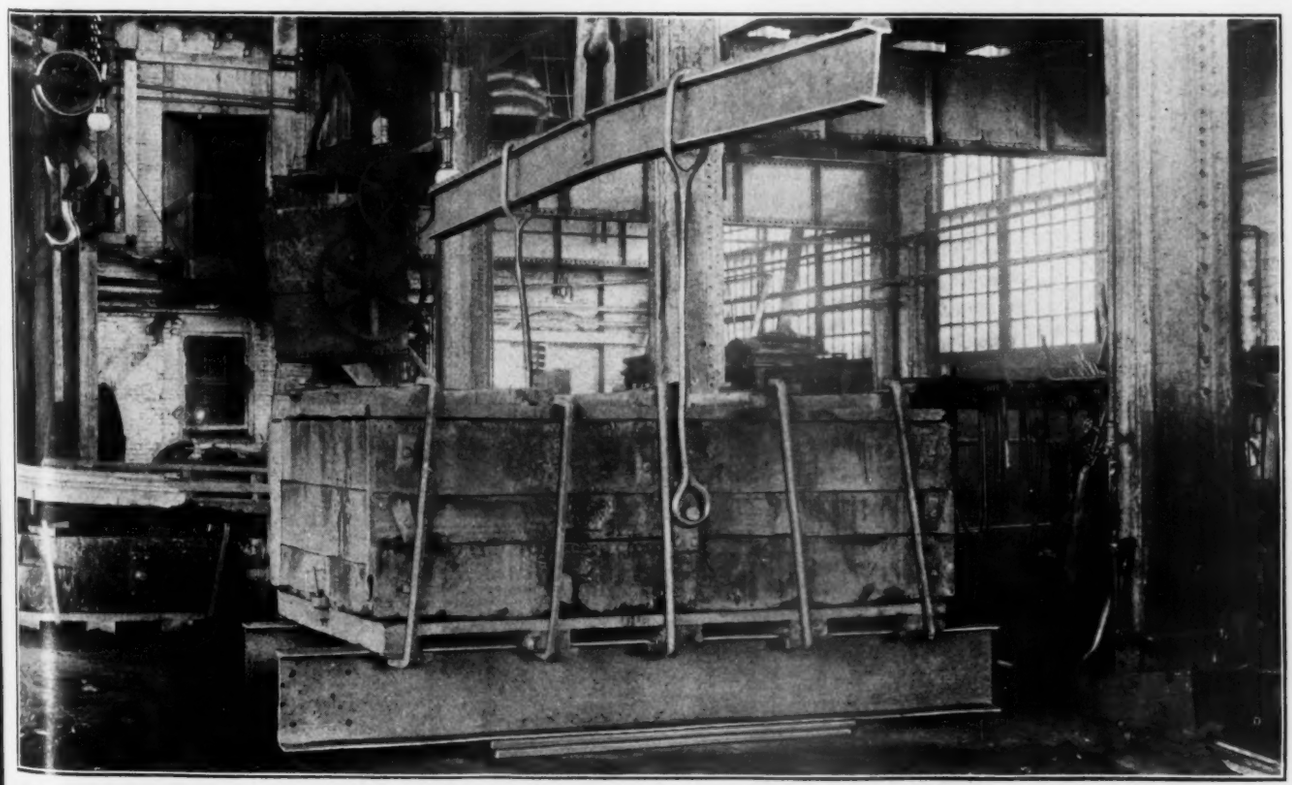

FIG. 1—DRAG HALF OF A CYLINDER MOLD RAMMED ON A JARRING MACHINE. THE FLASK IS 8 FEET 6 INCHES X 6 FEET X 3 FEET AND WEIGHS 10,000 POUNDS

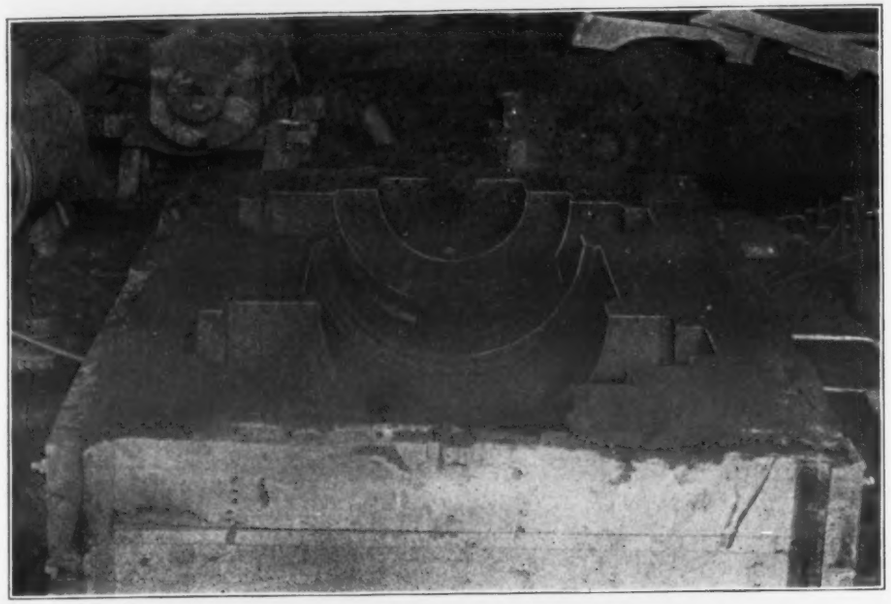

FIG. 2—CYLINDER MOLD AFTER THE PATTERN HAS BEEN DRAWN. THE FLASK IS SHOWN ON THE MOLDING MACHINE IN FIG. 1

FIG. 3—COPE HALF OF A LARGE CYLINDER MOLD MADE IN A FLASK 9 FEET 3 INCHES X 7 FEET 8 INCHES X 36 INCHES

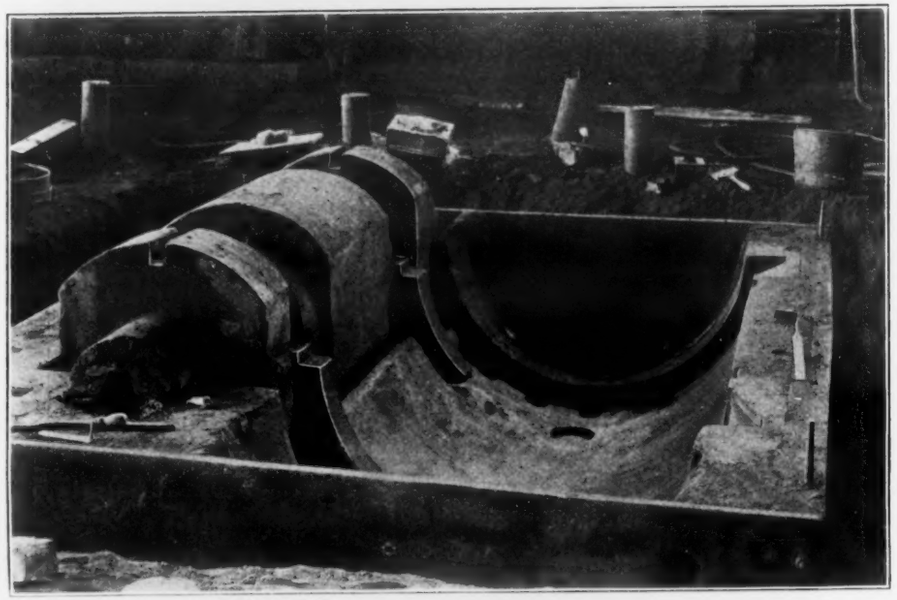

FIG. 4—STEAM CHEST CORE IN THE DRAG OF A CYLINDER MOLD. THE COPE IS SHOWN IN FIG. 3

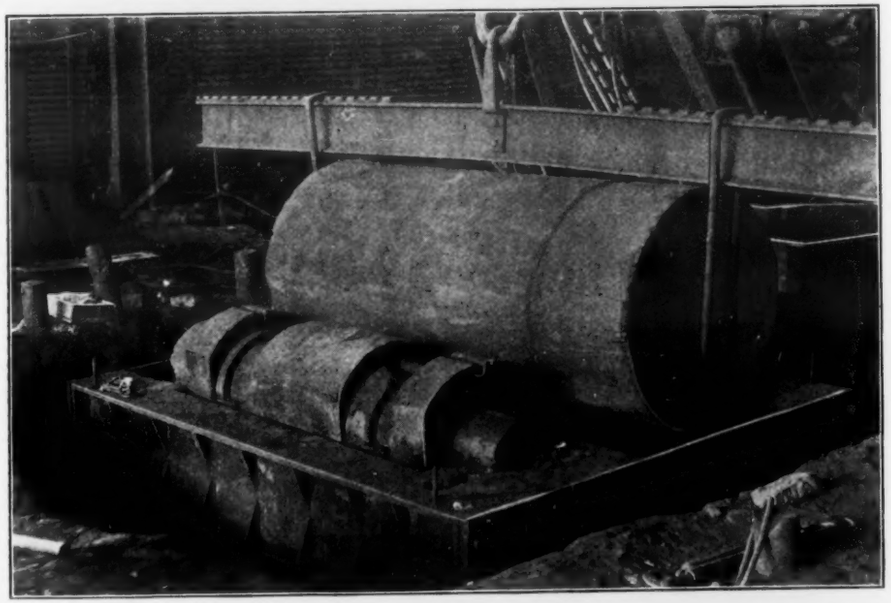

FIG. 5—LOWERING THE LARGE CYLINDER CORE IN THE DRAG HALF OF THE MOLD SHOWN IN FIG. 4

FIG. 6—ONE OF THE SMALLER JARRING MACHINES IS SHOWN ON THE LEFT AND MISCELLANEOUS WORK, MACHINE-MOLDED, IS SHOWN IN THE FOREGROUND

and so satisfactory have been the results that it is the intention to mold engine beds and cylinders, the cope and drag flasks of which will weigh from 20,000 to 30,000 pounds each, on jarring machines.

The present equipment consists of three machines, one of 14,000 pounds capacity installed by Wm. Demmler & Bros., Kewanee, Ill., and two of 3,500 and 7,000 pounds capacity each, furnished by the Herman Pneumatic Machine Co., Zelienople, Pa. Air is used at a pressure of 100 pounds and all of the large molds are dried.

Gas Engine Cylinder Mold.

In Fig. 1 is shown the drag flask of a large gas engine cylinder including the pattern which is mounted on a pattern board, and the flask as clamped weighs 10,000 pounds. It is 8 feet 6 inches long, 6 feet wide and 3 feet deep, and the table of the Demmler machine, which is shown slightly above the floor level, is only 60 x 52 inches. The cylinder of this machine is 16 inches in diameter. To support flasks of greater dimensions than the table, I-beams are used as shown, and flasks mounted in this way, up to 12 feet x 6 feet x 42 inches deep, have been successfully rammed. The time required for ramming the flask shown, was about 10 minutes, while one hour was consumed in filling the flask with sand, no conveyor having yet been installed for this purpose.

In Fig. 2 the drag mold of the cylinder rammed on the jarring machine,

FIG. 7—THE SMALL JARRING MACHINE AND SOME OF ITS PRODUCT

FIG. 4—STEAM CHEST CORE IN THE DRAG OF A CYLINDER MOLD. THE COPE IS SHOWN IN FIG. 3

FIG. 8—GAS ENGINE CYLINDERS MADE ON JARRING MACHINES. WEIGHT 3,650 POUNDS EACH

Fig. 1, is shown after the pattern was drawn by the overhead crane. From the illustrations it will be seen that very little time will be required to finish the mold.

Cope Half of a Cylinder Mold.

The cope half of the large cylinder mold made in a cast iron flask, 9 feet 3 inches x 7 feet 8 inches x 36 inches deep, is shown in Fig. 3. The weight of the finished mold is approximately 18,000 pounds. The steam chest core is shown in place in Fig. 4, and in Fig. 5 the cylinder core is being lowered into the mold by an overhead crane.

The large Herman pneumatic molding machine is shown at the left, Fig. 6, and miscellaneous floor work made on this machine is shown in the foreground. It includes the drag halves of four cylinder head molds, 26 inches in diameter, the drag halves of four funnels made two in a mold, and the drags of four core plates are shown in the background.

Smaller Work.

A small machine of the Herman type is shown at the left, Fig. 7, and the drags of various molds rammed on the same are shown in the foreground. These include three piston heads, four valve cage molds and four throttle valve molds. The flask on the machine is 2 x 4 feet and contains four wipers on one pattern plate.

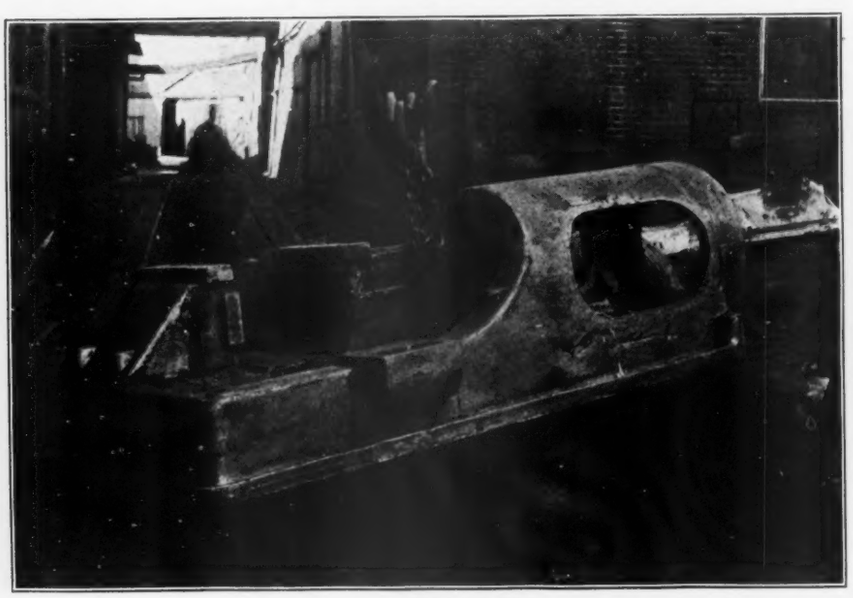

FIG. 9—GAS ENGINE BED RAMMED PARTLY ON A MOLDING MACHINE AND FINISHED WITH A PNEUMATIC RAMMER. WEIGHT 9,300 POUNDS

Two gas engine cylinders, 18-inch bore and 21 inch stroke, weighing 3,650 pounds each, are shown in Fig. 8. The molds were rammed on jarring machines, the patterns drawn by cranes, the molds dressed, cores set and the castings were poured the same day. The actual time for making each mold was 9 hours, one skilled mechanic and helper having been engaged on each.

Molding Machine Castings.

In Fig. 9 is shown a bed casting made partly on a molding machine and partly by hand. The machine was not of sufficient capacity to ram the mold when the flask was full of sand and only sufficient sand was put into the flask up to the capacity of the machine, and later the flask was filled and the ramming was finished with a pneumatic rammer. If the machine were of sufficient capacity to handle the load the mold could have been completed, the cores set and cast the same day. A skilled molder and a helper worked 9 hours on this mold and a handy man was engaged for three hours to assist in dressing the same. The weight of the casting is 9,300 pounds.

In Fig. 10 is shown the distance piece for a gas engine made on a molding machine. The pattern was drawn by crane, the mold dressed and the core set by a skilled molder and his helper in 9 hours. The weight of the casting was 3,800 pounds.

The two uncleaned castings shown on top of the bed, Fig. 11, are distance pieces for gas engines and weigh 960 pounds each. These were made on molding machines by a handy man and his helper in 9 hours. This record was made the second day after he was put on the work and he had been employed as a helper to a skilled molder for about six weeks.

PIG IRON SPECIFICATIONS

The January meeting of the Philadelphia Foundrymen's Association received the report of the special committee appointed a month previous to draw up standard specifications for pig iron. This committee is composed of Walter Wood, R. D. Wood & Co., chairman; A. E. Outerbridge Jr., Wm. Sellers & Co., Inc.; Dr. Richard Moldenke, secretary American Foundrymen's Association; George C. Davis, chemist; and H. L. Haldeman, Pulaski Iron Co. The association ordered the report printed and distributed and continued the committee for the handling of further matters arising in this connection. The full report follows:

Your committee would respectfully report

that, following the instructions of your association, they have, in drawing the enclosed specifications, abandoned the buying of pig iron by number. The tables are so arranged that different qualities of pig iron can be accurately designated by their chemical content. There are three points which, perhaps, it is desirable to speak of.

First—As buying by analysis fails as to a standard for newspaper quotations, it is proposed that there shall be a grade established upon which prices can be based, known as "No. 2," which shall be of a quality of metal similar to the foreign standard grading upon which warrants are issued, this grade to analyze as stated in the specifications.

Second—So that buyers and sellers can readily express the character of the metal they want, symbols have been put after each analysis, the combination of which into one word will express exactly what the buyer desires, thus saving considerable expense in telegraphing. Further, these symbols condensed into a word will be of value when warehousing iron, as the word written into the certificate will accurately describe the iron that is stored.

Third—If a purchaser wishes to split the steps at which silicons vary (0.50 per cent), the tables are so arranged that he can designate silicons with a difference only of 0.25 per cent.

Your committee believes that, with these explanations, the reason for the new departures will be entirely clear and that the tables are so arranged that it will be possible for any one in the foundry business to designate with precision the metal he desires.

Proposed Standard Specifications for Foundry Pig Iron.

Analysis—It is recommended that all purchases be made by analysis.

Sampling—Each carload or its equivalent shall be considered as a unit. At least one pig shall be selected from each four tons of every carload, and so chosen from different parts of the car as to represent as nearly as possible the average quality of the iron.

Drillings shall be taken so as to fairly represent the fracture surface of each pig. The sample analyzed shall consist of an equal quantity of drillings from each pig, well mixed and ground before analysis.

Percentage of Elements—Opposite each percentage of the different elements a syllable has been affixed so that buyers, by combining these syllables, can form a code word to be used in telegraphing such inquiries as they may desire to make.

CARBON.

Total carbon not less than 3.25 per cent.

SILICON.

Per cent.	Symbol.
0.50	Ca
1.00	Ce
1.50	Ci
2.00	Co
2.50	Cu
3.00	Cy
3.50	Ch

0.25 allowed variation.

SULPHUR.

Per cent.	Symbol.
0.03	Sa
0.04	Se
0.05	Si
0.06	So
0.07	Su
0.08	Sy

Maxima gravimetric method.

PHOSPHORUS.

Per cent.	Symbol.
Less than 0.20	Pa
0.30	Pe
0.60	Pi
0.90	Po
1.20	Pu
1.50	Py

0.15 allowed variation.

MANGANESE.

Per cent.	Symbol.
0.40	Ma
0.60	Me
0.80	Mi
1.00	Mo
1.20	Mu
1.60	My

0.20 allowed variation.

Example—Code word Ci-se-pi-ma represents Silicon, 1.50; sulphur, 0.04; phosphorus, 0.60; manganese, 0.40. Whenever standards one-half between the standards above are desired, they will be designated by the symbol X. Thus: "Cix" means 1.75 per cent silicon or in trade parlance 1.50 to 2.00 per cent silicon; and "Cox" means 2.25 per cent silicon, or in trade parlance 2.00 to 2.50 per cent silicon. For market quotations a grade shall be assumed to be known as No. 2 analyzing: Silicon, 2.50 per cent and over, and sulphur 0.04 per cent or under.

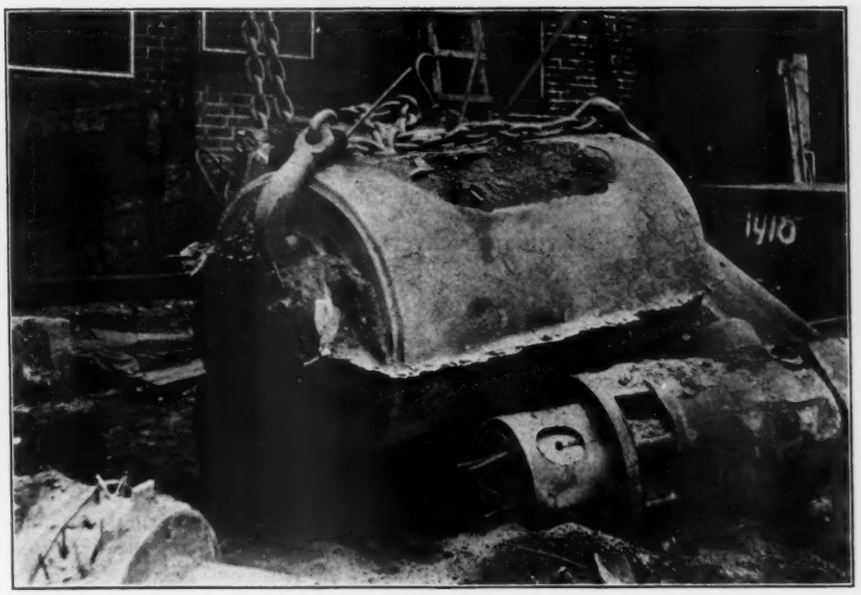

FIG. 10—DISTANCE PIECE FOR GAS ENGINE. MOLDING MACHINE JOB. WEIGHT 3,800 POUNDS

The association held its annual election and continued for another year the entire list of officials, as follows:

President, Thomas Devlin, Thomas Devlin Mfg. Co.; vice president, Alex. E. Outerbridge Jr., Wm. Sellers & Co., Inc.; treasurer, Josiah Thompson, J. Thompson & Co.; secretary, Howard Evans, J. W. Paxson Co.; executive committee—E. E. Brown, Thomas M. Eynon, H. L. Haldeman, George C. Davis, James S. Stirling.

FIG. 11—DISTANCE PIECES ON TOP OF ENGINE BED MADE ON MOLDING MACHINES

MANUFACTURE OF STEEL FOR CASTINGS*

Discussion of the relative advantages and disadvantages of the open-hearth and converter steel processes for the production of steel castings

BY BRADLEY STOUGHTON

THE United States contains about 170 active foundries devoted to the manufacture of steel castings, not including other steel plants where castings are occasionally produced, incidental to their regular business. Of these 170, about 101 can make open-hearth castings, 43 can make Bessemer converter castings, and 45† can make crucible steel castings, while the number of furnaces of the different kinds are: Acid open-hearth, about 85; basic open-hearth about 90; converters, the producing equivalent of about 27†, and crucible melting pots about 750. The tonnage of the different kinds of steel produced in 1904 and 1907 is shown in Table I. Even the astonishing percentage increase in the production of total castings is less significant than the increase in castings made by the basic process. This condition of affairs is too well known to require more than a passing mention, and is reflected in the production of steel for purposes other than castings, as shown by Table II. In short,

Table I—Steel Castings and Total Steel Produced in the United States.

	1904. Tons.	1907. Tons.	Increase, Per cent.
Acid open-hearth castings	203,915	379,401	86
Basic open-hearth castings	98,919	366,476	270
Bessemer converter castings	16,051	33,300	107
Crucible castings (estimated)	3,000	6,000	...
Total steel castings	321,885	785,177	146
Total steel, all kinds	13,859,887	23,359,637	70

it is now recognized that the growing scarcity of low-phosphorus ores, in comparison to the ever-increasing demand for them, is rapidly forcing upon all the steel manufacturers of this country the only process available to them for the reduction of phosphorus. Whether this circumstance is or is not a benefit to the steel casting industry is one of the objects of this paper to study.

The distinguishing features of the acid open-hearth process for making steel castings are:

An acid slag with the consequent inability to purify the metal from phosphorus or sulphur. This acid slag is a much less energetic oxidizer than is the basic open-hearth slag, with the result that the purification is less rapid and the steel also is less oxidized at the conclusion of the process (other things being equal). Furthermore, the amount of acid slag is only about one-half that of the slag in the basic open-hearth process, so that the blanket of heat between the flame and the metal is thinner and the heat efficiency is greater in the acid process.

The amount of steel scrap used in the acid process is much greater than in the basic, which is the result of two conditions just mentioned, viz.: the heat efficiency being high we can quickly melt a more infusible charge than is possible in the basic furnace, and the purification being slow, it is desirable to have less pig iron in the charge. The acid open-hearth process thus approaches a mere remelting process and, in this respect, resembles the crucible process, the chief differences being the larger size of charge and the fact that the metal is exposed in the same chamber as the flame.

Recarburization may take place in the acid furnace, but must be effected in the ladle in the basic process.

Flexibility of Composition and Tonnage.

The flexibility of chemical composition of open-hearth steel (both acid and basic) is very slight. Generally all the charge is "dosed" to the same composition and all the castings made from that heat must be alike. This greatly increases the difficulty of making steel castings of special carbon contents, or of alloy steels, because just enough castings to take the whole charge of a furnace, and no more, must be made ready from orders requiring the special material, and, even then, the scrap and risers must be kept separate in certain cases, as, for example, after making nickel steel.

The flexibility of both the acid and basic open-hearth process in regard to tonnage made is also very slight, because fuel economy and wear and tear on the furnaces demand that they be run continuously, if at all, and the capital invested in apparatus is too large to allow it to lie idle much of the time.

The waste of metal by loss and oxidation is less in the acid open-hearth process than any except the crucible process, and this is a potent factor towards economy.

Temperature of Metal.

As regards the temperature of metal produced, both the acid and basic open-hearth processes face the difficulty that the lining of the furnace must always be heated to a higher temperature than the metal in it. There is no limit within reason to the temperature we can obtain, but at high heats the furnace must be expected to suffer more in proportion than the metal gains.

Table II—Production of Acid and Basic Steel in the United States.

	1904. Tons.	1907. Tons.	Increase, Per cent.
Acid open-hearth	801,299	1,269,773	58
Basic open-hearth	5,106,867	10,279,315	101
Bessemer converter	7,859,140	11,667,549	48
Crucible	92,581	143,000	55
Total	13,859,887	23,359,637	70

Fuel Economy and Time of Operation.

The fuel economy of the acid open-hearth furnace is greater than any process except the Bessemer.

The time of operation in the acid open-hearth furnace is less than in the basic, chiefly because of its greater heat efficiency and its being more of a remelting than a purification process. It takes nearly twice as long as the crucible operation, however, and many times longer than the Bessemer.

Length of Campaign.

The campaign of the acid open-hearth furnace before it is necessary

*Presented at the December meeting of the Pittsburg Foundrymen's Association.

†The actual number of active converters is close to 60, but the majority of these are not capable of continuous production, so their producing efficiency is much less.

to cool it down for repairs is nearly 1,000 heats, as compared with 350 for the basic furnace, and 20 to 1,000 for the converters usually employed for castings.

Operation and Installation Costs of Acid Open-Hearth Furnaces.

The cost of installation of an acid open-hearth furnace is greater than for any but a basic furnace. A furnace of 15 to 30 tons capacity will cost from $12,500 to $30,000, depending upon layout, etc.

The cost of operation of the acid open-hearth is greater than the basic process and less than the converter and the crucible. Its expense is due chiefly to the high price commanded by the low-phosphorus, low-sulphur scrap and pig iron which it requires. One disadvantage of the open-hearth process as compared to the converter is that it costs more to teem into molds one large heat of metal at long intervals than to teem several small heats almost continuously, because the latter method permits of better organization, of pouring the steel over the lip of the ladle instead of through a nozzle, and avoids the occasional hurry to get the ladle empty before the steel cools and produces skulls, defective castings, etc.

Quality of Acid Open-Hearth Steel.

In quality, acid open-hearth steel stands above all except crucible, but for castings, acid steel has advantages over basic that do not apply when ingots are to be made and rolled. Under comparative conditions basic steel is the most liable of all to blow holes, both because the final slag, and therefore the metal, is more highly oxidized and because the basic slag is antagonistic to getting the desired amount of silicon into the steel. Moreover, the very low point to which sulphur is occasionally reduced in the basic process is an enemy to soundness, for a moderate amount of sulphur reduces wildness. The fact that the basic heats are longer is an additional temptation to rush them unduly, thus producing overoxidation at the end with all its attendant evils. Finally, the large amount of silicon added in recarburizing for casting work produces a special danger of rephosphorization from the basic slag.

It must be observed that the acid process is also open to dangers resulting in bad quality of metal, prominent among which is that of overoxidation during melting because there is so little reducing agent present. For the best quality of steel for structural work, engineers sometimes demand that the acid charge shall contain at least 30 or 40 per cent of pig iron, and that no oreing shall occur for at least half an hour before the steel is tapped.

Similar provisions for casting work would insure a better quality of acid castings but increase materially the cost of the process. Steel scrap in small pieces and a charge which melts cold, are conditions which increase the danger of over-oxidation.

Characteristics of the Basic Open-Hearth Process.

The basic open-hearth process employs a basic slag rich in lime—45 to 55 per cent including magnesia—with the consequent ability to rid the bath of phosphorus and an important amount of sulphur. The slag is large in amount, which reduces the heat efficiency of the furnace, and necessitates using a large proportion of pig in the charge, so that it shall melt easily. The slag also contains over 80 per cent of metallic oxides, including often 20 to 25 per cent of oxide of iron, so that the metal is likewise liable to be charged with oxide, lowering its quality and introducing a tendency to blow holes.

The scrap used in the basic furnace is usually only about 50 per cent of the charge, in order that there may be enough pig present to secure easy melting and furnish enough reducing agencies to prevent excessive oxidation of iron during melting.

Recarburization cannot take place in a basic furnace because the reducing agents added, especially silicon, will reduce phosphorus from the slag.

Even with the limited contact with the slag which exists in the ladle, the metal will contain often 0.020 per cent more phosphorus after recarburizing than before, but this condition is readily guarded against by previously reducing the phosphorus below the point determined upon as the maximum desired. It is only on those rare occasions when a violent reaction takes place between the metal and slag during recarburizing and a large amount of phosphorus is reduced that the steel is seriously affected.

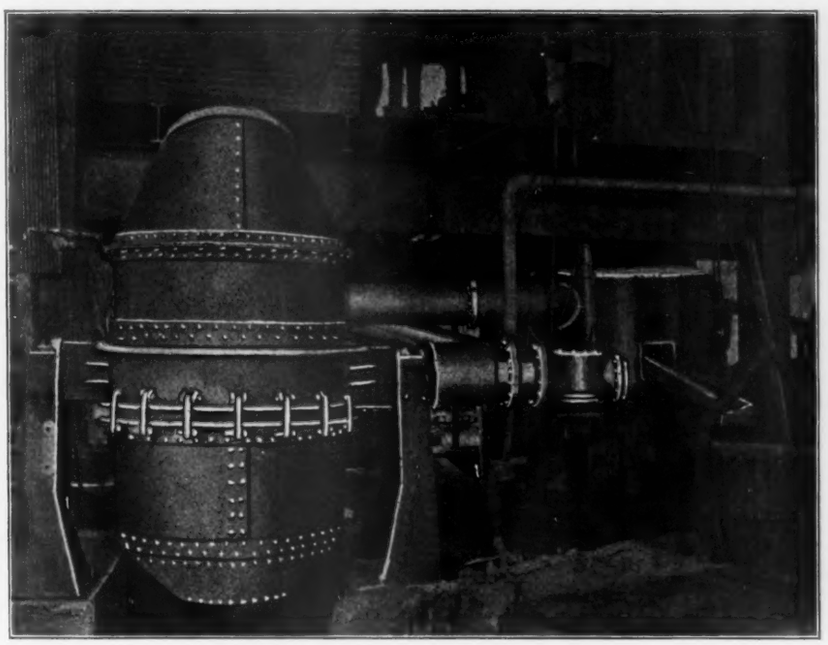

FIG. 1—STOUGHTON REMOVABLE BOTTOM CONVERTER

The flexibility of the basic open-hearth process, both in chemical composition and tonnage of the product, is very slight, for the reasons given under the acid process. The flexibility in composition of product may be increased by using a tilting furnace, but these are costly to install and keep in repair.

Loss of Weight.

The loss of weight between metal charged and produced in the basic open-hearth process is greater than that of the acid process, but is only one-third to one-fifth of the converter process. It is to be observed, however, that when very low figures for waste are obtained in the basic process, it is by means of excessive oreing, or of too much steel scrap in the charge, both of which have the effect

of lowering the quality of the castings by over-oxidation.

Temperature of Basic Open-Hearth Steel.

The temperature of basic steel is sufficient for all castings over 100 pounds in weight, and even smaller, if there are not too many of them to be poured at the same time, because then the length of time required for teeming makes the metal cool towards the end with the dangers of stopper troubles, misruns, etc. Small-sized heats would solve this difficulty, but even then the furnace will suffer from the high temperature to which it is heated, and open-hearth furnaces of less than 15 tons capacity are costly to operate per ton of product on account of their proportionately higher charges for labor in operation and repairs, their lower heat efficiency and their increased fixed charges per ton, these including interest on investment, superintendence, etc. It has been well contended that a shorter furnace will suffer less from expansion and contraction, but, as it is not good practice to cool down the furnace any oftener than is necessary, and as fuel economy and length of campaign, especially life of ports and roof, are also directly dependent upon the length of the working chamber, the latter factor will always far outweigh the former. One has only to observe the recent fuel economies obtained by increasing the capacities of ingot furnaces to 70 and 75 tons, and the readiness with which steel makers have adopted this change, to emphasize this condition as much as it merits it. Excellent quality of steel castings can, with due care and skill, be made in these small furnaces, and this circumstance deserves attention.

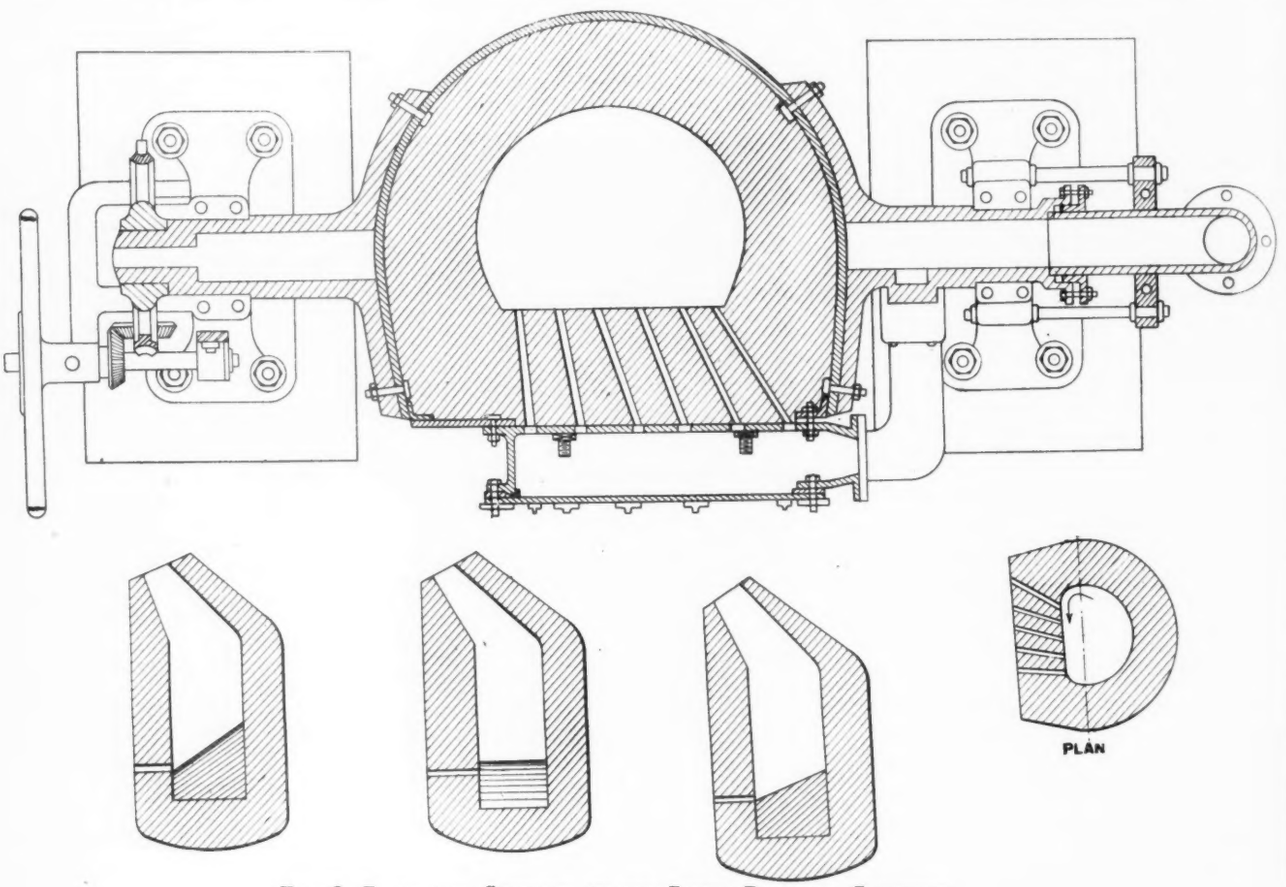

FIG. 2—PLAN AND SECTIONS OF THE ROBERT-BESSEMER CONVERTER

The heat efficiency of the basic furnace is the lowest of all those used for steel making, chiefly because the heat must penetrate a very bulky slag with low heat-conducting power in order to reach the metal. The more impure the metal used for purification, the greater will be the bulk of the slag necessary, although this circumstance is somewhat compensated for by the greater ease with which the metal melts, but the impure metal also requires a longer time for conversion, with the consequence of more fuel burned, so that there is a loss both in fuel and labor charges.

The basic open-hearth operation is also the longest of all, averaging perhaps an hour or so longer per heat than the acid process. This makes labor and fuel charges per ton high, and is the cause of the flexibility of the production being slight, when compared to the converter and crucible processes.

The campaign of the basic furnace is only about 350 heats, after which repairs must be made which are more costly than those of the acid furnace, and much more so than those of the converter or crucible furnace.

In cost of installation the basic furnace is highest of all, being a few hundred dollars more than the acid furnace on account of the greater cost for basic than for acid material.

Add to the labor and fuel charges of the basic open-hearth the costliness of its repairs, and we have its chief items of expense, but the cheapness of the pig and scrap suitable for it more than make up the difference, so that the basic furnace is the cheapest one in America in which to make steel.

Quality of Basic Open-Hearth Steel.

The quality of basic open-hearth steel is believed to be lower than crucible and acid open-hearth steel, for reasons already given. When compared with converter steel it seems

THE FOUNDRY DATA SHEET, FEBRUARY, 1909.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

STANDARD METHODS FOR DETERMINING THE CONSTITUENTS OF CAST IRON.*

Determination of Total Carbon.

This determination requires considerable apparatus; so in view of putting so many obstacles out of the way of its general adoption in cases of dispute, your committee has left optional several points which are felt to bring no chance of error into the method.

The train shall consist of a pre-heating furnace, containing copper oxide (Option No. 1) followed by caustic potash (1.20 sp. gr.), then calcium chloride, following which shall be the combustion furnace in which either a porcelain or platinum tube may be used (Option No. 2). The tube shall contain four or five inches of copper oxide between plugs of platinum gauze, the plug to the rear of the tube to be at about the point where the tube extends from the furnace. A roll of silver foil about two inches long shall be placed in the tube after the last plug of platinum gauze. The train after the combustion tube shall be anhydrous cupric sulphate, anhydrous cuprous chloride, calcium chloride, and the absorption bulb of potassium hydrate (1.27 sp. gr.) and tached to the aspirator bottle shall be connected to the prolong.

with prolong filled with calcium chloride. A calcium chloride tube at-

In this method a single potash bulb should be used. A second bulb as sometimes used for a counterpoise being more liable to introduce error than correct error in weight of the bulb in use, due to change of temperature or moisture in the atmosphere.

The operation shall be as follows: To 1 gram of well mixed drillings add 100 c. c. of potassium copper chloride solution and 7.5 c. c. of hydrochloric acid (conc.). As soon as dissolved as shown by the disappearance of all copper, filter on previously washed and ignited asbestos. Wash thoroughly the beaker in which the solution was made with 20 c. c. of dilute hydrochloric acid (1 to 1) pour this on the filter and wash the carbon out of the beaker by means of a wash bottle containing dilute hydrochloric acid (1 to 1) and then wash with warm water out of the filter. Dry the carbon at a temperature between 95 and 100 degrees C.

Before using the apparatus a blank shall be run and if the bulb does not gain in weight more than 0.5 milligram, put the dried filter into the ignition tube and heat the preheating furnace and the part of the combustion furnace containing the copper oxide. After this is heated start the aspiration of oxygen or air at the rate of three bubbles per second, to show in the potash bulb. Continue slowly heating the combustion tube by turning on two burners at a time, and continue the combustion for 30 minutes if air is used; 20 minutes if oxygen is used. (The Shimer crucible is to be heated with a blast lamp for the same length of time.)

When the ignition is finished turn off the gas supply gradually so as to allow the combustion tube to cool off slowly and then shut off the oxygen supply and aspirate with air for 10 minutes. Detach the potash bulb and prolong, close the ends with rubber caps and allow it to stand for five minutes, then weigh. The increase in weight multiplied by 0.27273 equals the percentage of carbon.

*Reported by the committee of the American Foundrymen's Association, Philadelphia convention, May 21-24, 1907.

DATA SHEET, No. 35, THE FOUNDRY, FEBRUARY, 1909.

STANDARD METHODS FOR DETERMINING THE CONSTITUENTS OF CAST IRON.

(Continued from Data Sheet No. 35.)

The potassium copper chloride shall be made by dissolving one pound of the salt in one liter of water and filtering through an asbestos filter.

Option No. 1.—While a pre-heater is greatly to be desired, as only a small percentage of laboratories at present use them, it was decided not to make the use of one essential to this method; subtraction of the weight of the blank to a great extent eliminating any error which might arise from not using a pre-heater.

Option No. 2.—The Shimer and similar crucibles are largely used as combustion furnaces and for this reason it was decided to make optional the use of either the tube furnace or one of the standard crucibles. In case the crucible is used it shall be followed by a copper tube 3/16-inch inside diameter and 10 inches long, with its ends cooled by water jackets. In the center of the tube shall be placed a disc of platinum gauze, and for three or four inches in the side towards the crucible shall be silver foil and for the same distance on the other side shall be copper oxide. The ends shall be plugged with glass wool, and the tube heated with a fish tail burner before the aspiration of air is started.

Graphite.

Dissolve one gram sample in 35 c. c. nitric acid (1.13 sp. gr.) filter on asbestos, wash with hot water, then with potassium hydrate (1.1 sp. gr.) and finally with hot water. The graphite is then ignited as specified in the determination of total carbon.

Determination of Silicon.

With one gram of sample, add 30 c. c. nitric acid (1.13 sp. gr.); then 5 c. c. sulphuric acid (conc.). Evaporate on hot plate until all fumes are driven off. Take up in water and boil until all ferrous sulphate is dissolved. Filter on an ashless filter, with or without suction pump, using a cone. Wash once with hot water. Ignite, weigh, and evaporate with a few drops of sulphuric acid and 4 or 5 c. c. of hydrofluoric acid. Ignite slowly and weigh. Multiply the difference in weight by 0.4702, which equals the per cent of silicon.

Determination of Sulphur.

Dissolve slowly a three gram sample of drilling in concentrated nitric acid in a platinum dish covered with an inverted watch glass. After the iron is completely dissolved, add two grams of potassium nitrate, evaporate to dryness and ignite over an alcohol lamp at red heat. Add 50 c. c. of 1 per cent solution of sodium carbonate, boil for a few minutes, filter, using a little paper pulp in the filter if desired, and wash with a hot 1 per cent sodium carbonate solution. Acidify the filtrate with hydrochloric acid, evaporate to dryness, take up with 50 c. c. of water and 2 c. c. of concentrated hydrochloric acid, filter, wash, and after diluting the filtrate to about 100 c. c., boil and precipitate with barium chloride. Filter, wash well with hot water, ignite and weigh as barium sulphate, which contains 13.733 per cent of sulphur.

(To be continued.)

DATA SHEET, No. 36, THE FOUNDRY, FEBRUARY, 1909.

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

probable that the basic steel would be preferred except for its liability to blow holes. These pests of the casting industry are more feared by the consumer than the producer because he sometimes has to spend money machining the castings before he finds them defective, and this represents a financial loss to him in addition to the delay before castings can be made to replace them. In actual tests, the basic and converter steels run very close together, although it is possible to produce castings extra low in phosphorus by the basic process when this is a consideration, and therefore more durable under shock tests, although this is seldom, if ever, applied so far as we know.

Characteristics of the Converter Process.

The distinguishing features of the converter process are:

An acid slag with the consequent inability to purify the metal from phosphorus or sulphur and the resulting necessity of purchasing pig iron low in these two elements, and therefore higher in price. The amount of the slag is only about 10 or 11 per cent of the weight of the bath and it is even more tenacious of oxygen than the acid open-hearth slag, because lower in metallic oxides. In this respect the metal is well protected from over-oxidation, but this is more than overbalanced by the rapidity of the conversion and the strongly oxidizing conditions which produce it. In short, there is more iron burned to oxide in the converter process than in any of the others, but no iron oxide is added to the slag from extraneous sources as in both of the modifications of the open-hearth process.

The converter uses a relatively small amount of steel scrap—say 25 per cent or so—being merely what can be melted with the iron in the cupola.

Recarburization may take place in the converter and this is a source of slight saving since there is a notable reduction of iron from the slag thereby. It also insures a more perfect mixing and distribution of carbon and silicon.

Flexibility of the Converter.

The flexibility of the converter process in the composition of steel produced is greater than that of any of the other processes. This requires no explanation in relation to the open-hearth processes since the smaller size of the converter heats and the circumstance that metal can be taken out of the converter in lots of 50 pounds or more, each dosed separately, gives it undoubted advantages. As compared to crucible metal its relative flexibility depends upon the circumstance that the amount of carbon in crucible steel is controlled partly by chance and is liable to vary from the intentions of the manager. With great care the analysis will be close to pre-determined limits and this quite sufficient for all ordinary casting purposes, but lacks the regular exactness which can be obtained in the converter process. It has been claimed that poor blowing, poor dosing and excessive slopping to which the converter is liable will produce irregularities in analysis greater than are

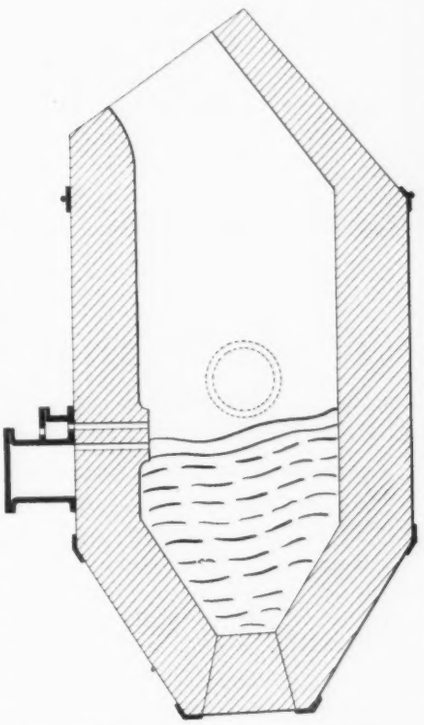

FIG. 3—TROPENAS BESSEMER CONVERTER

liable to occur in the open-hearth or crucible processes, but my own experience leads me to believe the opposite, and that irregularities due to any of these causes are unnecessary and uncommon. It has also been claimed by the advocates of the open-hearth process that it is not possible to stop the converter and take samples during a blow as is usual in open-hearth practice. Such is not the case, however, as it is possible to take samples when desired and is occasionally practiced in most converter plants, but is usually unnecessary.

The flexibility of the converter process in regard to tonnage made is one of its chief advantages, although here it cannot claim any superiority to the crucible process. Not only may a two-ton converter be economically operated to produce anywhere from 10 to 60 tons in a working day, but it may lie idle every other day, or even longer, with only slight additional cost, since the capital invested is small in amount and the skill required for superintendence, blowing, etc., is not so great but that it may be acquired in a short time by the foundry chemist or some other employe who when the converter is not operating will be advantageously employed in some other way, and the labor of repairing does not require a special man but can be performed by an ordinary molder's helper, properly supervised. It is not necessary to keep the converter hot between its periods of operation as is the case with the open-hearth furnace, because the converter suffers no material damage in cooling and heating and it can be pre-heated for the first blow, with a small amount of wood and coal. One great advantage of flexibility in production aside from allowing for fluctuations in demand is the ability occasionally to make a few extra castings at short notice to oblige a customer or to replace defective castings with minimum delay. The average time between heats will be 20 to 25 minutes and it is possible to make from 25 to 30 heats in 10 hours, if desired.

Converter Losses.

The waste of metal in the converter process is its greatest disadvantage and source of expense as compared with all the other processes. The fact that in its early years in this country, inexperienced and careless practice made the loss often as high as 25 or 30 per cent, caused rather exaggerated accounts of this feature to be spread, but it is quite possible to operate any of the smaller converters with a waste not exceeding 20 per cent of the weight of metal charged into the cupola. I have operated a converter continuously for some months with a waste not exceeding 15 per cent between the weight of the metal charged in the cupola and that of the molten steel in the ladle, nor is this practice a personal factor, as others have done the same thing for a period of five years. This requires, however, an amount of attention to detail which has not always been given to the converter process for the reason that those who operated it formerly were usually either not educated in this country and did not see the necessity of due attention

to this particular or else were persons who had not been trained in steel making.

It is possible to get a higher temperature in the converter method with less cost for repairs and less wear and tear on the furnace than is the case in the open-hearth process, for the reason that the converter metal is made hotter than the furnace, while the open-hearth furnace is always hotter than the metal in it. It is said that this is one of the chief reasons why converter metal is especially adapted for the manufacturer of small castings, and also for its lesser liability to blow holes, but there does not seem to be any good reason why metal made in a small open-hearth furnace, say of five tons capacity, should not be equally suitable for light castings, provided one is willing to endure the very high fuel costs that the use of such a furnace would entail on account of its poor combustion and the short life of ports which a short, open-hearth furnace always has to endure. It has been argued that the high temperature of the converter metal is a danger and source of "hot cracks" and defective castings, because of incorrect judgment of the casting temperature, but it is no more difficult to judge the temperature of the steel in the ladle from the converter than to judge the temperature of the flame in the open-hearth furnace.

The fuel used in the converter operation is the impurities in the metal and all that is required in addition is that for melting in the cupola and for heating the converter and ladles once each day.

Time of Converter Operation.

The time of the Bessemer operation is about 14 minutes to which must be added that necessary for pouring the steel into ladles and pouring in a new charge. As it is customary in some shops to take the whole of the steel in hand ladles, there will be in such a case quite a delay between the operations. The short time of the conversion enables large sized castings to be made occasionally, although the converter process is not suited to making regularly single castings whose weight is greater than the capacity of the furnace. Nevertheless it is not unusual to make four-ton castings with one two-ton converter, saving the metal from the first blow until that from a second blow is ready and six-ton castings are sometimes made with the same apparatus.

Length of a Converter Campaign.

The campaign of the converter will depend upon the type of vessel used; the lining in the neighborhood of the tuyeres lasts only 20 to 25 blows and in those converters made all in one piece such as the Tropenas, the Robert, the Zenzes, etc., it will be necessary to put the converter out of commission and cool it down for repairs at the end of this period. In those steel casting converters made with removable bottoms, however (Stoughton type), it is only necessary to change to a new bottom whenever the tuyeres are worn out and the upper part will last for 1,000 heats or more. Moreover, the removable bottom greatly cheapens and facilitates repairs, because those converters made all in one piece require a great hole to be cut in the lining of the side, in order to get at the part to be repaired, so that one removable bottom converter with one spare bottom has a daily capacity almost equal to three converters of the same size built all in one piece.

Cost of Converter Installation.

The cost of installation of a converter with accessory apparatus will be less than that of an open-hearth furnace of equal capacity. How much less will depend upon the type of converter. For example one must have at least three two-ton converters built all in one piece to equal in capacity one 15-ton open-hearth furnace.

The cost of these converters would be:

Converters and lining	$5,000
Blower with motor	2,000
Cupolas and linings	950
Total	$7,950

One two-ton converter with one spare interchangeable bottom would

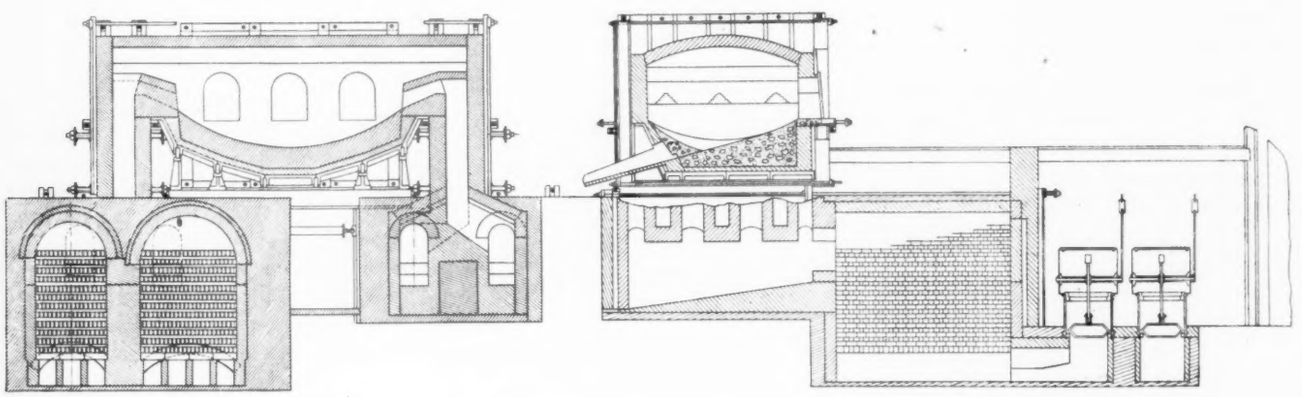

FIG. 4—FIFTEEN-TON SIEMENS OPEN-HEARTH FURNACE AT PLANT OF OTIS STEEL CO.

Table III—Characteristics of the Different Processes of Making Steel for Castings.

	Acid Open-Hearth	Basic Open-Hearth	Converter	Crucible
Purification is	Acid	Basic	Acid	.....
Amount of slag, per cent	6 to 15	15 to 30	10 to 11	.....
Steel scrap used, per cent	85	50	25	.....
Recarburize	In furnace	In ladle	In furnace	.....
Can be operated	Continuously	Continuously	Intermittently	Intermittently
Flexibility in analysis	Small	Small	Great	Great
Flexibility in composition	Small	Small	Great	Small
Metal loss, per cent	3	5	15 to 30	1 to 2
Metal or furnace, hotter?	Furnace	Furnace	Metal	Furnace
Fuel used, per cent	25	30	15	125
Time of conversion	7 hours	8 hours	20 minutes	4 hours
Campaign in heats	1,000	350	20 to 1,000	Several thousand
Cost of installation	Large	Largest	Small	Smallest
Cost of operation	Medium	Smallest	Small	Largest
Danger of blow holes	Medium	Greatest	Small	Least
Quality of castings	Second	Lower	Lower	Best

have almost as great a capacity and the cost would be:

Converter and lining	$1,650
Spare bottom	375
Blower with motor	2,000
Cupolas and linings	950
Total	$4,975

Cost of Converter Operation.

The cost of operation of the converter process is less than any except the basic open-hearth, for reasons already outlined, the chief item of expense in the converter process being the waste of metal. It is only fair, however, to deduct from the waste of metal a small amount in consideration of the saving in defective castings due to the freedom from blow holes in which respect the converter has a decided advantage over the basic open-hearth, and, to a less extent, over the acid open-hearth also. In making light castings there will also be a further saving by the converter process due to a smaller number of misruns and skulls.

Quality of Converter Steel.

The quality of converter steel is about on a par with that of basic open-hearth steel. It will be higher in phosphorus, unless only the very purest metal is used for charges, but it will, however, have the advantage of being higher in silicon, and much less liable to blow holes. This latter feature is due partly to the higher silicon, but is no doubt increased by the high temperature of the converter metal, because it exceeds the acid open-hearth steel also in its freedom from blow holes. No doubt, the high temperature of the converter metal assists in freeing it from its dissolved gases, and also from oxide of iron which is an important cause of blow holes, it being a theory maintained by several that the hotter the steel the more readily will the oxide of iron separate itself from its state of suspension in the bath. The fact that the converter metal is usually poured over the lip of the ladle assists in freeing the metal from gas, producing soundness, and also lessens the size of gates required.

There are more than 15 steel casting plants using a total of more than 25 Tropenas converters; three plants, with a total of five converters of the removable bottom type, and from one to three converters each of the Bookwalter, Robert-Clapp-Griffiths, Wills, Fisher, Zenzes and other types.

Characteristics of the Crucible Process.

The crucible process for steel castings is characterized by the use of expensive raw material which costs as much or more than the product of any of the other processes—high charges for crucibles, labor and fuel and a very low cost of installation, being only a few hundred dollars for the erection of a coal-fired crucible furnace. The quality of the crucible steel is higher than that of the product of any of the other processes—chiefly on the account of the protection of the metal from oxidation and contamination by fuel, as well as because of the small units in which the steel is made and the consequent necessity for care and attention in the process.

SHOP HEATING---A TREATISE CONTAINING MANY PRACTICAL SUGGESTIONS

BY F. R. STILL*

WHAT system of heating is best adapted for the shop under consideration is frequently an important question. There are all kinds of methods—some good, many poor, and a large number positively bad. It is not within the province of this article to analyze the merits and demerits of the various systems, but to point out the advantages obtainable with a good system of heating and to explain how it should be laid out, installed and operated to secure the best results.

A good heating system is quite as essential to the success of any manufacturing plant as good materials, good tools and good light. Employes will not work at their highest efficiency when uncomfortable; neither will high grade mechanics stay in a shop which is poorly equipped when there are other shops having modern conveniences for their comfort. First class work can only be turned out by first class mechanics. If they cannot be obtained, the natural result is disorganization, a poor grade of mechanics and inferior output. Even if experienced mechanics can be retained, they cannot put forth their best efforts, either in thought, carefulness or speed, if the atmosphere is impure, or the temperature is uncomfortably warm or cold.

The Up-to-date Plant.

There are instances arising every day which prove conclusively that the heating plant has a positive and direct influence on the quality and quantity of the output. It does not require exceptional abilities for observation or analysis to discover this. Which plant is it that grows the faster—one with poor and antiquated equipment or one which has everything up to date? Which one of the two would make the better impression upon you? Did you ever find salamanders or stoves in a pushing, growing, up-to-date plant?

Did you ever associate the shop conditions as you found them with the business done and the progress made? While the entire success of the plant cannot be attributed to the sanitary conveniences and the comfort afforded the men, yet it is a safe conclusion that the same management given a shop devoid of these things, could not make the progress attained with them.

Those who recognize the advantages of a good heating plant frequently do not realize the necessity for designing it when the plans of the building are being made. The result is that instead of arranging other things of much less importance to accommodate the heating plant, the latter has to be contorted, cut down, or squeezed into whatever space is available after everything else is taken care of. This makes the plant either expensive to install or to operate, and often it is so contorted or dwarfed in one way or another as to fail to

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give the satisfactory results naturally expected.

Laying Out the Heating Plant.

One who has gone through the experience once, forestalls a recurrence by having the heating system laid out on the plans of the building so as to form an integral part of the construction. In the hands of a competent engineer, the owner of the building is thus pretty sure to get what he wants and to avoid petty annoyances and dissatisfaction later on.

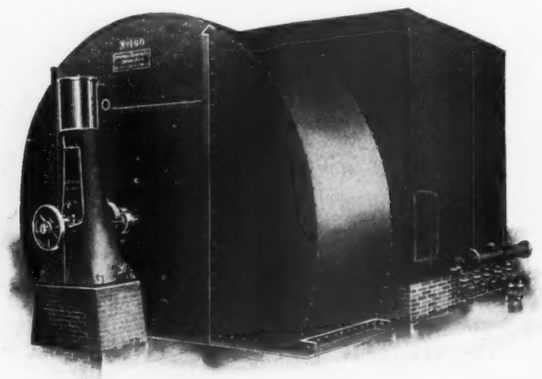

FIG. 1—BLOWER AND BANK OF STEAM COILS ENCLOSED IN A STEEL CASE

When it comes to laying out a heating plant, the character of the building and the purpose for which it is built must be carefully studied. What answers for one type of building is totally unsuited to another of a different type. Again, what serves very nicely in a building of a certain type, in which a particular class of work is done, proves anything but satisfactory in a building of the same type, in which a different kind of work is done.

This can be made clear by comparing a machine shop with a paper mill. They are similar in size, shape and exposure. In the machine shop, no steam or moisture is emitted to condense on the walls and roof; hence many of them are heated in a fairly satisfactory manner by direct radiation, consisting usually of steam coils strung around the outside walls. Such a system would never do in a paper mill, where every day several tons of water are thrown off into the atmosphere in the form of steam from the drying cylinders over which the paper passes. This steam must be taken up by a copious circulation of warm, dry air, or it will drip from the roof and run down the walls in streams.

Problem of Heating the Foundry.

Foundries are much like the paper mills just cited, as the steam rising from the molds when pouring off, as well as the smoke and noxious gases, should be removed. Roof ventilators, monitor lights or ventilating sashes are very poor makeshifts indeed. Perhaps they will let some of the smoke escape and with it some of the gases and most of the heat; but most of the gases, being heavier than the air, lie in the lower strata near the floor and are not affected by the roof vents. Further, instead of removing the steam, they only accelerate the annoyance from it, as the warm air which escapes through the roof must be supplanted by outside air, and this, not being properly heated, chills the air within the building, thus reducing its capacity to carry moisture, thereby causing greater precipitation than there would be were no attempt made to ventilate the building. Instances are numerous where so much moisture has been condensed on the roof as to spoil the molds on the floor, and this even in foundries well heated, so far as temperature is concerned, by direct radiation.

Then again, apart from the use to which the building is put, consideration must be given to its character.

The tendency nowadays is to put up lofty buildings. Such structures have steel frames, walls made almost entirely of glass, with only narrow pilasters between, and shallow panels of brick or concrete above and below the openings. The exposures are relatively enormous, requiring large amounts of heating surface, yet the spaces available for steam coils are limited to such an extent that they are often insufficient for the heating surface required.

Furthermore, when the space is sufficient, the banking of such great heating surfaces into a small space, makes it uncomfortable for the employes who have to work near them.

Blower System.

It is these and many other features that have made the blower system popular, as it has proven efficacious in almost every building of whatever character, when it has not been misapplied. Many of the designers of such heating plants seem to have a penchant for trying to make this system do all sorts of unusual and almost impossible stunts. The system is so flexible and so positive in its action that many persons seem to think it capable of defying nature's laws. But occasionally nature asserts her rights in a most emphatic manner, with the result that a plant fails to do what was expected of it. This, however, is no fault of the system, but rather of the man who designed the plant.

The blower system, sometimes called hot blast system, plenum system, or mechanical heating and ventilating system, is so universally known as to need little more than the most superficial description of the apparatus, though there is plenty to be learned about the best way to install it.

The apparatus consists of a large blower, driven by an engine or motor, and a deep bank of steam coils enclosed in steel, Fig. 1. The blower causes the cold air to circulate rapidly in contact with the outer surfaces of the steam pipes, Fig. 4, thus becoming heated to a temperature ranging from 120 to 160 degrees Fahr., thence it passes into conduits or distributing ducts which convey it to the departments to be heated, where

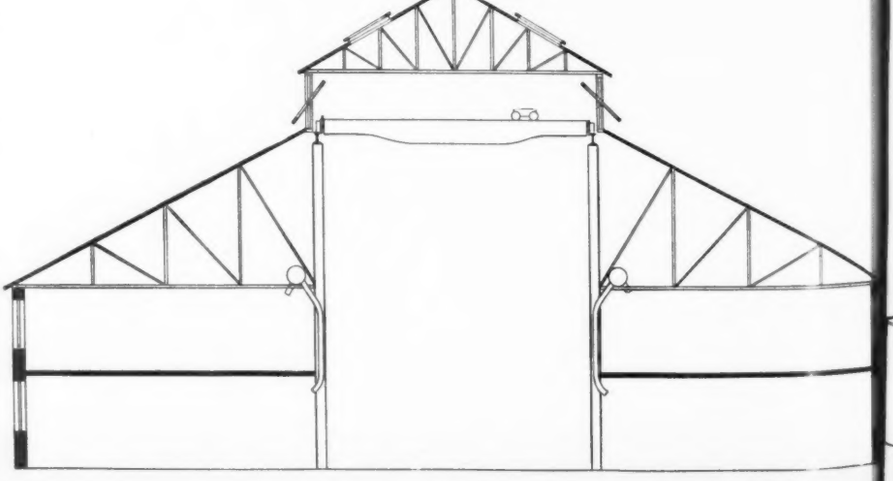

FIG. 2—METHOD OF DISTRIBUTING THE HEAT BY CARRYING BRANCH DUCTS TO A POINT NEAR THE FLOOR

it finds egress from the ducts through branch outlets. These outlets are sometimes simply sheet iron pipes with adjustable dampers for regulating the amount of air discharged; others end in register boxes with cast iron register faces covering them; again others end in cast iron or sheet steel hoods, all depending on the local conditions and requirements. The ducts are usually made of galvanized sheet iron, for all types of buildings, except where it is necessary to place them underground, in which case they are built of brick, vitrified tile or reinforced concrete.

Ducts.

It is always advisable to run the ducts inside the building because of the heat wasted if they are run outside, be they above or below the ground. It is, furthermore, advisable to make the ducts of galvanized iron and suspend them in the open air overhead, if possible, as the loss of heat from underground ducts is enormous.

A fair idea of what this loss sometimes amounts to may be gained from mention of a case a few miles north of Grand Rapids, Mich., at a large silk mill. The basement wall is built of stone about 3 feet thick. The duct is built of brick above the basement floor, along the outside wall, beneath the windows.

In the winter when the outside temperature is down near zero and there is a foot or more of snow on the ground, the grass is perfectly green for a space extending out from the building nearly 10 feet in width, and for 10 feet more there is no snow, though the grass is dead.

Had the duct been made of iron and run inside the building, all this heat would have been radiated into the surrounding atmosphere, thus helping to maintain the required temperature, instead of keeping the grass green. The location of trunk line ducts and the disposition of the branches therefrom is a matter requiring considerable practical experience and good judgment.

The modern shop has a trussed roof, the bottom chords of which are often 30 to 50 feet above the floor. The ducts have to rest on these trusses and it is impossible to drive air from them to the floor in a way that will produce satisfactory results. This method has been tried often enough, but there still remain others who must be convinced of its impracticability by trying it themselves. The only way to obtain an even distribution of heat, is to discharge heated air at such points as it is most needed and where the effect will be most appreciated.

To distribute the heat evenly necessitates running the ducts to all cold spots; it is needed the most in the lower strata near the floor, not up among the roof trusses; the greatest benefit is derived from the system by diffusing the warm air close to the floor, keeping the lower strata in circulation and thereby warming it by mixing with it the warm air discharged from the ducts.

The best way to bring this about is to extend the branch ducts from the main trunk line over to the walls or to posts not more than 20 feet away from the outside walls, then down toward the floor, ending 4 or 5 feet from the floor as shown in Figs. 2 and 3. The air should discharge directly toward the floor or at only a slight angle from perpendicular. This method will be found most effective in machine shops, foundries and other lofty structures.

Heating Building Several Stories High.

For buildings which are several stories in height, each story being from 10 to 16 feet high, the treatment should be different. With them, it is possible, and sometimes advisable, to introduce the air near the ceiling, blowing downward at an angle of 30 to 45 degrees from horizontal.

Frequently, buildings of this character are quite effectively heated from one or two galvanized iron stand pipes run up through the middle of the building with outlets into each story, Fig. 5. This method is practical in buildings not over 60 feet wide; if the building is not over 100 feet long, one riser will be sufficient.

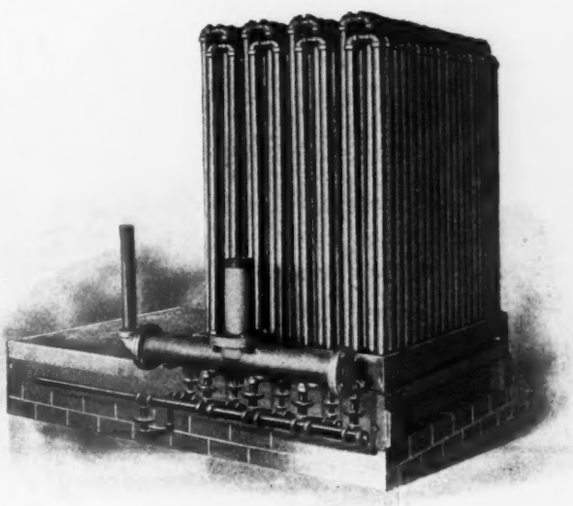

FIG. 4—STEAM COILS THROUGH WHICH COLD AIR CIRCULATES

For cotton, woolen or silk mills, it has become almost the universal practice to build vertical warm air flues on the outside face of the pilasters, on both sides of the building, Fig. 6. These flues usually have a 2-inch air space built into the brick work to insulate them. The air is admitted to each story about 8 feet above the floor. Deflecting "mill dampers" regulate the volume of air discharged through each opening. The various flues can be supplied at their base from a main duct built either of masonry or galvanized iron.

Trunk Line Ducts.

For manufacturing plants, it is customary to make the trunk line ducts of such an area as will convey the required volume of air at a velocity varying from 1,500 to 2,400 feet per minute. In high buildings used for heavy and coarse work, where most of the employes stand or move about considerably, the velocity can be much higher than in shops divided into several stories, or those in which the work is more or less sedentary, like the manufacture of shirts, gloves, etc., where the employes sit all day, simply feeding the material into machines.

Air currents or drafts are of no ma-

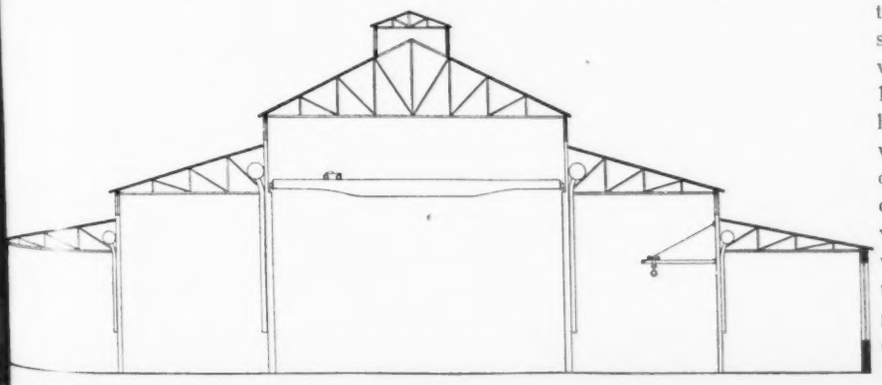

FIG. 3—ANOTHER ARRANGEMENT OF BRANCH DUCTS FOR THE DISTRIBUTION OF HEAT

terial moment in the former shops, while in the latter they will produce great discomfort, if not sickness. Therefore, the latter class should have the main ducts of sufficient area to keep the velocity down to 1,200 to 1,800 feet per minute and the branches should be proportioned to a velocity of 600 to 1,200 feet.

Another advantage the blower system possesses, infrequently brought to notice, is the cooling and comforting effect it has in oppressively warm weather in the summer time. Simply running the fan will, of itself, greatly relieve the oppressiveness, and when cold water is circulated through the coils the difference is very noticeable.

Shop Temperature.

There is often a wide variation of opinion as to the best temperature to maintain in cold weather. As a general proposition, in foundries and other buildings where the work is active and somewhat vigorous, a temperature of 50 to 55 degrees is sufficient. In machine and wood working shops, it should be from 60 to 65 degrees. In shoe, clothing and other factories employing help where the work is more or less sedentary, the temperature should be 68 to 72 degrees.

The basis for determining the amount of heating surface is the most difficult point to settle. In northern climates, the outside temperature occasionally drops down to 10 degrees below zero, and in Minnesota, Dakota and Montana it goes even lower than 30 degrees below zero. If a plant is designed for these extremely low temperatures, it is too large for the conditions prevailing for 95 per cent of the year. It therefore becomes a question of very fine judgment as to just what should be the basis upon which to figure. The following table will give a fair idea of what the resulting temperatures will be under the varying outside atmospheric conditions, the basis being zero:

Resulting Inside Temperature.

Class of building.	Temperature desired inside.	Temperature outside 30 degrees below 0.	Temperature outside 20 degrees below 0.	Temperature outside 10 degrees below 0.	Temperature outside 0.	Temperature outside 10 degrees above 0.	Temperature outside 20 degrees above 0.	Temperature outside 30 degrees above 0.
Foundries	50	22	32	41	50	57	63	70
Machine shops.	60	34	43	52	60	67	73	78
Clothing shops.	70	45	55	63	70	76	81	86
Paint shops...	80	59	67	74	80	85	89	92

From the table it will be noted that for climates where the temperature does not drop below —20 degrees, an inside temperature based on zero outside gives very fair average results; but for climates where the temperature may be from —30 degrees to —10 degrees for several days at a time, the basis is not low enough. For such cases, if the basis is zero, the resulting temperature should be figured about 10 degrees higher than normal, or the temperatures in the table given for machine shops should be taken for foundries and the temperatures for clothing shops should be taken for machine shops.

On the other hand, if the coldest temperature ever reached is zero, and the protracted cold spells are usually at outside temperatures of from 10 to 20 degrees above zero, the basis for determining the size of the plant in zero weather would be 40 degrees at zero for foundries and then taking the tabulated temperatures of foundries for machine shops and the latter for clothing shops.

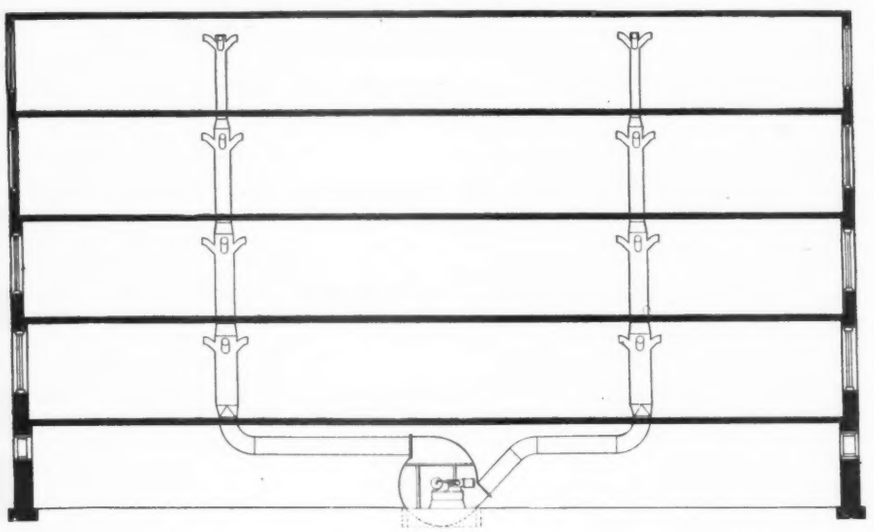

FIG. 5—PLANT HEATED BY STAND PIPES RUN THROUGH THE MIDDLE OF THE BUILDING

In this way considerable unnecessary expense can be saved in the initial cost of the plant; it will be smaller and hence much less costly to operate. It is all well enough to argue that the steam can be cut down on the heating coils and the speed of the fan reduced when the weather conditions moderate, but this is usually not done, simply because it is nobody's business to see that it is done, and instead of thus economizing in the cost of operation, one will invariably find the shop windows and doors open when it becomes too warm inside. Therefore, the more nearly the size of the plant conforms to the needs during average weather conditions, the less it will cost to operate it, and this can only be brought about by settling first on what temperature will be satisfactory for the few days of extremely cold weather. This applies to any heating system, and if anything, should be given greater weight for any other than the blower system, as no other can be so readily adjusted to varying weather conditions.

With the blower system, one or more sections can be cut out of the heating coils and the blower slowed down in moderate weather; or, steam at a higher pressure can be turned into the coils and the fan be driven at maximum speed for extremely cold weather.

Conclusion.

To sum up: The proper heating of factory buildings is of as much importance and involves as many problems as anything the manager has to decide. It is as essential as the transmission, tools or light, and very much more complex. It should be considered with the plans of the building and made an integral part of the construction, having in mind all the time the equipment best suited to the type of building and the purpose for which it is built.

Fresh air is essential to life. Man can clothe himself to withstand cold, but he cannot get along without air. The purer it is, the better health he has and the faster he can work. Therefore, any heating system which does not provide for fresh air should have no consideration.

Something in the way of a ventilating plant is required where manufacturing processes generate steam, smoke and gases. Cold air only makes bad matters worse, so the ventilation necessarily becomes a part of the heating system.

The subject of the proper temperature to maintain in shops is one that does not receive the careful attention

it should. It is, if anything, worse to overheat a shop than to underheat it. A fair average temperature should be arrived at and the heating system be flexible enough to keep the shop comfortable when the temperature outside is above and below average.

The distribution of the heat is very important and must be varied with the nature of the building and the work done within its walls. Consideration must also be given to the air velocities, for the purpose of ventilation.

While the cooling of a building is not of the utmost importance, it certainly has great advantages in many ways, and if a system makes it possible of accomplishment without complication or great expense, it becomes a valuable asset to any plant.

SEMI-STEEL AND SOFT STEEL CASTINGS.

By N. W. Shed

Question:—We are engaged in the malleable foundry business, but occasionally require castings for almost immediate delivery, inasmuch as some of our customers cannot wait until the malleable castings are made. Can you give us a steel or semi-steel mixture to be melted in crucibles and cast in green sand molds, which will give a good surface, perfectly sound? The castings we would like to make in this way have an average weight of from two to 50 pounds. We would like to use a mixture of this kind to tide over our customers until their malleable castings are available.

Answer:—I would suggest using a charcoal pig iron containing 1.40 to 1.50 per cent silicon. If charcoal iron is not available, use coke iron containing silicon, 1.50 per cent; sulphur, 0.02 to 0.03 per cent; phosphorus, 0.10 to 0.20 per cent; and manganese, 0.50 to 0.60 per cent. If the manganese is low in the pig iron, add four or five ounces of pulverized, 80 per cent ferro-manganese to each crucible. The mixture should contain 80 per cent of pig iron and 20 per cent of steel scrap. Plate shearings or punchings will do. If you have low phosphorus cast iron scrap on hand, the mixture should be approximately as follows:

Pig iron, 70 per cent; steel scrap, 20 per cent; cast iron scrap, 10 per cent.

Before pouring, add ½ per cent of ferro-manganese or ½ pound to each 100-pound crucible charged. This mixture makes a strong casting with considerable ductility. It is necessary that the metal be poured hot.

A more fluid metal may be made by using 50 per cent of low phosphorus pig iron, 20 per cent of high phosphorus pig iron, 20 per cent of steel scrap and 10 per cent of cast iron scrap. This metal is not as strong as the one previously referred to, but it works well in many cases. The above mixtures are called semi-steel.

If a straight steel mixture is desired, it would be well to have a mixture of high and low carbon steel in the crucibles, using a small amount of ferro-silicon. The ordinary steel castings usually contain silicon, 0.25 to 0.40 per cent; sulphur, 0.03 to 0.06 per cent; phosphorus, 0.04 to 0.06 per cent; carbon, 0.30 to 0.60 per cent, and manganese, 0.30 to 0.40 per cent. This is obtained by using 40 per cent of low carbon steel, 40 per cent of high carbon steel and 20 per cent of sprues. To prevent blow holes, a small amount of aluminum is usually added as the metal runs into the mold. Steel castings that are to be machined and which are generally cast in dry or green sand, will prove satisfactory if not very much machining is done. It will require good judgment to arrange proper gates and risers on molds for a soft steel mixture, as the shrinkage must be taken into account.

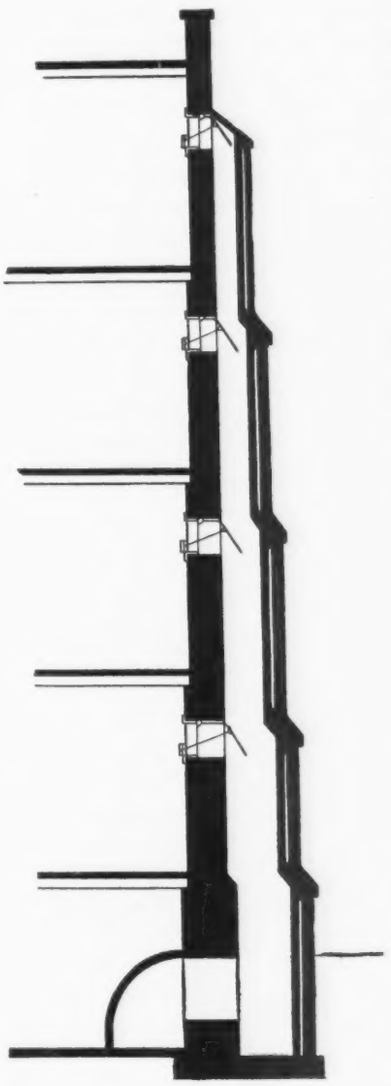

Fig. 6—Vertical Warm Air Flue on the Outside Face of the Pilasters

CHARGING A 30-INCH CUPOLA.

By W. J. Keep

Question:—Our cupola has a 27-inch lining which has been burned out to 30 inches above the tuyeres. There are four tuyeres, 4 inches square, 8 inches above the sand bottom. Blast is furnished by a fan blower. Our iron is either dull, or if we make it hot, it melts very slowly, and we cannot get the full capacity of the cupola. Can you advise us how to charge properly?

Answer:—You should add four more tuyeres and the same rules for charging applies to all cupolas. Before charging iron, your wood must be burnt to charcoal and the coke should be well ignited. The fire should be lighted two hours before iron is expected. Have a solid bed of coke 18 inches above the tuyeres before charging the iron. In a cupola of this size the iron should be broken into pieces weighing about 30 pounds each, and all scrap should be broken so that none of it is larger than the pig metal. Charge the pig iron evenly and close on the coke and the scrap on top of this to fill all holes. The entire iron charge should average about 6 inches thick. The coke should be broken into pieces about 4 inches square, and this should be charged to about the same depth as the iron. After the sixth charge, add 10 pounds of limestone on the coke. You may be able to increase the iron charge. You can readily ascertain the weights of the charges when the cupola is running well.

NEW CORE COMPOUND.

A core compound is the subject of a patent granted to Solomon Haley, Los Angeles, Cal. It consists of water one gallon; resin, one-half pound; glue, one-quarter pound; dextrine, one-half pound and caustic soda, one-quarter pound. The resin and glue are boiled with the water and then the other materials are added. After 24 hours the mixture is ready for use. The compound is to be used in the proportion of one to 15.

DISTRIBUTION OF PATTERN SHOP WORK

Discussion of the routine of this department together with a modern system for the conduct of its affairs

BY OSCAR E. PERRIGO

THE ROUTINE work of the pattern shop has been the subject of considerable discussion from time to time, but such consideration as the subject has received has been devoted to certain phases of the work, rather than to formulating any specific system or routine for the everyday work of the shop.

This department is one which costs the establishment many thousands of dollars each year. Its workmen are nearly always high grade mechanics who command good wages. Their work is not only exacting from a mechanical point of view, but usually of a nature that requires good judgment and ability in many ways. Even with a good working drawing, the patternmaker must plan his pattern and determine how he shall build it up so as to produce the most rigid and enduring model. He must decide where to divide it to the best advantage and how to arrange the cores to produce the best results. He must not only know all about the characteristics of the different kinds of wood of which his patterns are to be composed and their action when in wet sand, but he must possess much of the foundryman's knowledge of the shrinkage and other peculiarities of metals, particularly warping and similar distortion. All these and many other conditions operate to effect the efficiency of his work.

PATTERN ORDER CARD

ORDER NO. _____ DATE _____ 190

Foreman: Please make the Patterns, Core Boxes, etc. for

As per Drawings Nos. _____

This work must be completed on or before

Charge all Time on Job Cards to above Order Number.

Charge all Material used, on the back of this Card.

SIGNED	APPROVED
CLERK	FACTORY MANAGER
WORK COMPLETED _____	
DELIVERED TO _____	FOREMAN PATTERN SHOP

The Foundry

FIG. 1—OBVERSE SIDE OF PATTERN ORDER CARD 4 x 6 INCHES

Rush Orders.

Considered from this point of view, it becomes important to the success of the department, and in its proper proportion to the welfare of the establishment in general, that due care be used in all that relates to its efficient management, to the end that the money spent in it, whether much or little, shall not fail to bring its corresponding benefit to the plant.

It is often the case that the authority for giving orders for work in the pattern shop is not well defined and properly limited. Usually the chief draftsman, and frequently any other draftsman who happens to be working upon drawings which will require patterns, feels perfectly free to make out an order for the patterns; and without knowing or being particularly concerned as to the condition of the work in the pattern shop, or the influence of his action upon other work, matters, possibly of greater importance, will make it a rush order, and it goes in with all the importance which its fiery hue gives it and the pattern is rushed through, only to develop later that it is not really needed for several weeks, while its hurried order has obliged the pattern foreman to lay aside for a time, patterns from which castings are wanted at once.

Difficulties of the Pattern Shop.

Again, the foundry foreman may have a customer's or a stock pattern that he thinks would mold better if it had "a little more draft on this side" and "that core box filled up a hair where the core sits into the print." It sounds simple, but the extra draft may be on a piece 10 or 12 inches deep, and the core box may be troublesome to handle. In reality it may be only a fancy of some molder who is, by common consent among his fellows, a sort of authority on pattern work as well as molding, and if his advice in this case is acted upon by the pattern shop foreman it may result in a "call down" by a machine shop foreman who walks in a few days after with, "Say, who told you to trim off that pattern; didn't you know that we didn't have stock enough on that casting to hardly get under the scale when we planed it? You ought to put some on the pattern instead of taking it off." And so it goes until there is much unnecessary and often positively harmful work done, and pattern expenses improperly increased.

Correcting Abuses.

To correct such abuses, it is first necessary to determine who shall order new patterns, and the repairs and changes in existing ones. Theoretically, all primary orders emanate from the factory manager or managing head. Practically they may come from several different sources, but to re-

ler them effective they should be approved by the managing head of the actory, for the reason that it is not nly his privilege, but his duty to know what orders are "in the works."

Orders for new patterns may originate with the chief draftsman or in the superintendent's office. In the ordinary routine, those from the drafting room will be for recently designed work and will be frequently in sets. Those from the superintendent's office will ordinarily be for some special tool or fixture or some casting needed for repairs to machines or other equipment, which may not be from regular drawings made in the drafting room. In practice it will usually be found preferable for all

MATERIAL ACCOUNT

ORDER NO._____ DATE _____ 190__

QUAN.	MATERIAL	RATE	AMOUNT
	Pattern Pine		
	Common Pine		
	Cherry		
	Mahogany		
	Fillets		
	Rapping Plates		
	Dowel-pins		
	Pattern Letters		
	Screws		
	Nails		
	Shellac		
	Profit on Material		
	Total		

FOREMAN PATTERN SHOP

The Foundry

FIG. 2—MATERIAL CARD. REVERSE SIDE OF PATTERN ORDER CARD

these to go through the drafting room so that proper records can be made of them.

Routine Work.

Orders for changes in existing patterns due to improvements or changes of design, should originate in the drafting room, without regard to the authority upon which the change of drawings has been made, and careful records of such changes should be made in the drafting room.

Orders for repairs of patterns will be of three kinds: First, such repairs as are necessary from time to time to maintain them in proper condition for use. Such repairs may be upon orders originating with the foundry foreman, the superintendent or the chief draftsman.

The expense of such work will be charged, first, to maintenance of equipment; second, repairs made necessary by reason of injury to the pattern while in use in the foundry. The order will originate with the foundry foreman, and the expense will be charged to the foundry as an inter-departmental charge. Third, such repairs upon customer's patterns as may be necessary to put them in proper condition to mold, and to maintain them in that condition. The orders will originate with the foundry foreman and the expense will be charged to the customer, unless there is an agreement to the contrary.

Order Blank for Patterns.

For new sets of patterns or patterns from original designs, whether made from drawings made in the plant or from those furnished by a customer, the form of order is shown in Fig. 1. Space is provided for a brief description of the work and of the drawings or blue prints. Instructions as to the limit of time fixed for the completion of the work, and the method of charging for time and material on the job are given. This order is made out on the authority of the superintendent, mechanical engineer, or chief draftsman, and signed by the clerk writing it. It then goes to the factory manager, or managing head of the plant for his approval, after which it is sent to the pattern shop foreman, together with such drawings or blue prints as may be necessary for the proper execution of the work. At the bottom of this order is a space for entering the time when the work is actually completed and to whom it is delivered, and these facts are authenticated by the signature of the foreman. This will often save disputes and misunderstandings later on, possibly when a delay in turning out castings is said to be due to not having the pattern at the proper time, and similar cases.

Material Account.

Upon the back of this card is a form for a material account, as shown in Fig. 2. This is necesary in the work of the pattern shop as it is impractical for the patternmaker to draw his stock and material directly from the store room in the manner prescribed for the machinist or machine operator, as the lumber and small supplies, such as rapping plates, dowels, screws, nails, etc., are kept in stock in the pattern shop, and charged as used on the job. Therefore it is not convenient or practical to actually draw them from the store keeper, from whom the account may be sent to the cost department.

Requisition for Lumber.

While the lumber is actually kept in or near the pattern shop, so as to be convenient for use, theoretically it is under the charge of the store keeper and the foreman will issue regular requisitions for it as for other articles that may be actually in the

EMPLOYEE NO._____

NAME _____

ORDER NO._____

DATE _____

DAY		IN	OUT	IN	OUT	TOTAL
F	A.M.					
	P.M.					
S	A.M.					
	P.M.					
S	A.M.					
	P.M.					
M	A.M.					
	P.M.					
T	A.M.					
	P.M.					
W	A.M.					
	P.M.					
T	A.M.					
	P.M.					

TOTAL HOURS_____ MIN._____

RATE _____

AMOUNT _____

The Foundry

FIG. 3—ORDINARY SHOP TIME CARD FOR RECORDING CLOCK, 2⅝ x 7 INCHES

store room. These requisitions may be made out by the leading man on the job, but will usually be written by the clerk and signed by the foreman. For this purpose, the same blanks will be used that are provided for the other departments of the plant.

By the method prescribed, the order card contains the material account made up by the pattern shop foreman. The form may be so modified as to also contain a time sum-

mary, made up by the cost department from the daily job time cards. It will be noticed that spaces are provided for entering the rates of the different items of material, for extending the amounts and for adding the required percentage for profit on the material. If the time expended on the job is also entered on this card, the proper amount for overhead burden charges may also be entered as a proper part of the account. If this method is used, the order card will contain in brief the entire history of the job and thus be exceedingly useful for reference by the factory manager, superintendent, engineers and similar officials.

PATTERN REPAIR ORDER

ORDER NO._____ DATE _____ 190____

MAINTENANCE	CHARGE TO FOUNDRY	CHARGE TO CUSTOMER

Foreman: Please Repair_____

As follows:—_____

Charge all Time on Job Cards to above Order Number.

Charge all Material used, on the back of this Card.

	APPROVED
ORDER CLERK-FOUNDRY FOREMAN	FACTORY MANAGER
WORK COMPLETED_____ DELIVERED TO_____	FOREMAN PATTERN SHOP

The Foundry

FIG. 4—PATTERN REPAIR ORDER, 4 x 6 INCHES

Pattern Repair Order.

Repairs upon patterns should be handled with considerable care otherwise a good deal of unnecessary work will be done and unauthorized expense incurred for labor and material. For this purpose, an order blank shown in Fig. 4 is used. This is similar to the one shown in Fig. 1, but shows distinctly to what account the expense is to be charged. This fact must be determined sooner or later and if left to the discretion of the cost keeper or one of the bookkeepers there is very liable to be mistakes made owing to a lack of definite information as to the exact nature of the work.

In a large concern the cost of pattern repairs is quite an important expense and each item should be accurately assigned to one of the three accounts mentioned, those of Maintenance of Equipment, Foundry Expense, and to the customer when it is properly so chargeable. The decision as to which account should bear the expense is best left with the superintendent or factory manager, usually the former, as he is in somewhat closer touch with the mechanical work than the factory manager who has many commercial interests to demand his attention. In assigning the charge to any one of these three accounts the others are erased by drawing a line through them. It will be of considerable advantage to have the orders for repair of patterns of three shades of color, for instance from the superintendent, pink; from the chief draftsman, light blue; and from the foundry foreman, light green. Thus the source of the order is at once recognized by all who handle it. The back of these orders will have the material account as shown in Fig. 2, printed on them, and filled out in the manner described above.

Job Time Card.

The time account will be made up from the records on a job time card of the form shown in Fig. 3, used in a recording time clock. A card is made out for each order and is recorded in the clock when the job is commenced; also, whenever the day time card is "rung in" or "rung out," and when the job is completed, thus making an accurate record of all time put on the order. As the time represented by an aggregate of the job time cards must check up with that of the day time cards by which the workmen are paid, it is certain that the job time has been properly distributed to the various orders handled.

Having received the proper orders for the new work of the pattern shop and the requisite drawings illustrating the castings that are required, with all the various dimensions necessary, and in many cases describing certain more or less obscure portions of the drawings, it becomes the foreman's duty to properly distribute the work among his workmen.

Distribution of Work.

It is assumed that in selecting and organizing his force, the foreman has been guided by the principles set forth in a previous article published in the February, 1908, issue of THE FOUNDRY, by which the workmen are classified according to individual lines of work. Briefly, this plan provides for the use of some men who are not

WORK DISTRIBUTION RECORD

ORDER NO._____ DATE _____

DESCRIPTION OF WORK

DISTRIBUTION	
Leading Man_____	Order Received_____
Second " _____	Work Commenced_____
Third " _____	Material Ordered_____
Apprentice_____	Material Received_____
Mill Men_____	Work Completed_____
_____	Value of Time_____
Finishers_____	Value of Material_____

The Foundry

FIG. 5—WORK DISTRIBUTION CARD, 3 x 5 INCHES

skilled patternmakers, yet who, on account of their ability in certain allied lines, do much useful work more economically than skilled patternmakers and thereby serve to increase the efficiency of the department.

Thus, what are frequently called "mill men" are employed in planing lumber, cutting it to dimensions upon the rip saw and cutting-off saw, sawing out segments and laying them up, and similar classes of work. The finishing operations upon patterns, such as fitting the rapping plates, waxing, sandpapering, putting on pattern letters and figures, varnishing and rubbing down, can be done by a cheaper grade of men or by apprentices.

The classification referred to divided the force into (a) skilled patternmakers; (b) lathe men; (c) segment men; (d) band saw men; (e) circular saw men; (f) planer men; (g) finishers; and (h) apprentices. Foreman, assistant foreman, clerk and laborers were not classed as regular pattern shop workmen, although the foremen of forces up to 10 men are generally expected to do more or less work as skilled patternmakers. While the workmen under classes c, d, e and f should be good men in their several jobs, they need not be skilled patternmakers. When the force is 20 men or less, one man will do the work of the segment man and the band saw man, and another the work of the circular saw and the planer man. In a force as small as seven men, one man will do the work of the lathe man, segment man and band saw man.

DIMENSION LUMBER

ORDER NO. _____ DATE _____

KIND OF LUMBER

PIECES	THICKNESS	WIDTH	LENGTH

Signed _____

Approved _____

FOREMAN

The Foundry

FIG. 6—DIMENSION LUMBER MEMORANDUM, 3 X 5 INCHES. THIS CARD IS WHITE

Work of the Pattern Shop.

The work of the pattern shop is properly divided into the eight operations of (1) providing the lumber; (2) cutting it up; (3) planing; (4) shaping the lumber and building up parts of the pattern, as segment work, large pieces for turning, etc.; (5) lathe work; (6) patternmaking proper, the work of skilled patternmakers; (7) finishing the patterns; and (8) recording and storing the patterns. By thus classifying and systematizing the work as well as the workmen it is possible and entirely practical to formulate a definite system of shop routine or management in distributing or apportioning the work.

GLUED-UP WORK

ORDER NO. _____ DATE _____

KIND OF LUMBER

_____ Pieces, built up of _____ inch stuff; to finsh to the following dimensions.

THICKNESS	WIDTH	LENGTH

Signed _____

Approved _____

FOREMAN

The Foundry

FIG. 7—YELLOW CARD FOR GLUED-UP WORK, 3 X 5 INCHES

Assuming that we have a force of 30 men, including the foreman, assistant foreman and a clerk, there will be 14 skilled patternmakers, two lathe men, one each segment, band saw, circular saw and planer men, two finishers, four apprentices and one laborer.

While there are many jobs of pattern work upon which but one skilled patternmaker can be employed, there are also many upon which several may be used to advantage, each man being assigned to some definite portion of the work. In such cases the leading man, who is, for the time being, a gang boss, lays out the work, decides upon the manner of building up the pattern; where it is to be parted and the loose pieces necessary; the method of coring and such extra core prints as may be needed to facilitate the venting of the cores. In complicated patterns he will usually have the advice or instruction of the foreman or assistant, and it is frequently desirable to call the foundry foreman into the consultation also.

Skill of the Workmen.

Among the skilled patternmakers there will always be those having special ability or fitness for certain classes of work. One man may take a special interest in the building up of large and complicated patterns, and show much forethought and good judgment in planning the work and in handling such assistants as may be assigned to the job.

Another will be expert in the planning of patterns in which an elaborate and intricate scheme of coring is necessary. A third will be most efficient in patterns of complicated form in which there is much "gluing-up and digging out." A fourth will be very proficient in planning the sweeps and various forms of strickles for loam molding and facilities for dry sand work. Each of these will, of course, work to the best advantage upon such work as is made up principally of his specialty.

SEGMENT WORK

ORDER NO. _____ DATE _____

KIND OF LUMBER

_____ Pieces, built up of _____ segments _____ inches thick to a _____ course, to finsh to the following dimensions.

DIAMETER OUTSIDE	DIAMETER INSIDE	TOTAL THICKNESS

SKETCH

Signed _____

Approved _____

FOREMAN

The Foundry

FIG. 8—PINK SEGMENT WORK CARD, 3 X 5 INCHES

The foreman should be well informed upon this question of the special fitness of the individual men of his force, studying their ability in the different classes of work so as to keep each man engaged upon that class of work in which he is the best posted and most efficient. This is one of the most important duties of the pattern shop foreman and one in which he can be of much value to his employers.

Work Distribution Card.

The order for work having been received by the foreman, he will proceed to select the men best fitted for the job. Having decided this matter, he will fill out a work distribution card of the form shown in Fig. 5. At the top of this card is the order number and date, together with a brief description of the work, so that it may be readily identified. On the first half of the card is given the names of the men composing the gang on the job. This is carried out in the same manner, even if there is only one pattern-maker assigned to the work. On the second half is given various dates and necessary items of information, as for instance, the ordering of any special material and the date of its receipt, which is entered in consequence of the influence on the completion of the work due to delays in receiving necessary material. After the order is completed, the cost of the time and material is also entered for future reference.

The object of this record is that it is a very convenient method by which the foreman can keep track of the distribution of work in his department. It forms a ready source of reference at all times of the jobs that have passed through the department and the names of the men who did the work. This information is very important in case there is subsequently found an error in a pattern. These cards are also valuable in cases where the foreman is called upon to make estimates upon proposed work similar in kind to that previously done and recorded.

The distribution card having been filled out, the order for the work is passed to the leading man mentioned on it, who thereby becomes responsible for the work. Job time cards are also made out by the foreman or his clerk for the men who are to work on the job and these are "rung in" when they have completed the work they are on and ready for the new job. Ordinarily these distribution cards and the job time cards will be made out some time before they are required, so that there may be no delay in starting a new job when the old one is completed. By this method, the foreman is enabled to plan the work of his department considerably in advance of the daily routine work, and at such times as he can most conveniently attend to this duty, and have the cards written up and placed in a waiting rack ready for the different workmen when they are through with their current jobs.

The work being in the hands of the leading man and the drawings or blue prints furnished him, he will proceed to study them and to plan the actual work of making the pattern. When he has decided these matters, he will make his calculations as to the dimension lumber, glued-up material, segment work, etc., that will be required. It is the custom in many shops where special men are employed to get out dimension lumber, to give them the necessary figures on any sort of a slip of paper or even on a bit of board. The custom is a slipshod method and there is no excuse for its toleration. Mistakes are liable to be made, figures sometimes changed and much trouble ensues.

MATERIAL ACCOUNT

KIND OF LUMBER	QUALITY	THICKNESS	FEET USED
Signed			
		Total	

The Foundry

FIG. 9—MATERIAL ORDER CARD

Dimension Lumber Memoranda.

To avoid these difficulties, memoranda cards are filled out on the form shown in Fig. 6, which gives a list of all dimension lumber needed for the job except that glued-up for cylindrical work and that required for segment work. For glued-up work other than segment work, the form shown in Fig. 7 is used. For segment work the form shown in Fig. 8 is available. In this form a space is provided for a sketch, which will be necessary for bevel gear patterns, cone patterns and the like. If sketches are necessary with the other memoranda, they will be made on one or more cards or pieces of paper and attached to the memoranda card. These cards are signed by the head executive, and in order to keep the foreman in touch with the operations of the shop, they are approved by him before work is commenced on them.

Material Account.

On the back of these cards is a form, shown in Fig. 9, for a material account. This is filled out and signed by the mill men who get out the dimension lumber, glued-up stock or segment work, making proper allowance for waste in each case, and the account turned in, with the lumber, to the leading man who signed it. He will turn in these memoranda cards with the order for the work to the foreman when the job is completed, and he will account for it to the storekeeper.

By the methods described, a systematic and businesslike plan of handling these matters is provided and accurate records are kept, not only for the cost department, but for future reference by the foreman and any other officials who may have occasion to consult them.

Pattern work on which only one man can be employed, or a pattern-maker and an apprentice, will be enterd upon a distribution card in the same manner as though several men were engaged upon it. As far as possible each man will be furnished with the kind of work he prefers and upon

which he is most expert. The consideration of the foreman in this respect is usually appreciated by the men and a considerably greater product turned out than would otherwise be the case.

Repair Work.

It is frequently the custom in pattern shops to give most of the repair work to apprentices. This is not usually good management, either on the score of efficiency or economy. Generally, patternmakers do not like to do repair work. There is, however, an occasional man who is particularly efficient at this work and who would as readily do it as any other kind. The writer once had a man who would do, of this class of work, more than twice the amount of work that any other man in the shop could do, and do it well, too. He had a peculiar ability in making rapid changes in existing patterns to suit new demands that made him particularly valuable. The foreman should always endeavor to have such a man if possible. This does not mean that apprentices should not be taught to do this work, and, in fact, all classes of work which a patternmaker is likely to be called upon to do. But he should do his share of repair work as a matter of proper instruction rather than because it is a class of work that the skilled patternmaker feels rather superior to taking up.

Work for Unskilled Men.

In the distribution of work among the men, it should not be forgotten that the matter of sandpapering, varnishing, setting, rapping and lifting plates, putting on pattern letters and figures, can frequently be done by men receiving hardly more than half the pay of skilled patternmakers, and thus relieve the patternmaker of work that he usually does not have much fondness for. The same may be said of much of the core box work. Lathe work, to be done well and accurately, and at the same time economically, requires peculiar mechanical ability, and the man who is expert at it should be kept engaged upon it as a matter of economy as well as efficiency.

Thus, in the matter of distribution of work in the pattern shop the system of the machine shop may be followed very closely: to organize the force with men particularly fitted to the different classes of work; to ascertain what particular class of work each man is best fitted for; and then to keep him engaged upon that class of work with as little interruption as possible. Then we shall see the efficiency of the machine shop and manufacturing departments duplicated in the pattern shop.

PRODUCTION OF MALLEABLE CASTINGS--XI

Various methods of cleaning and inspection---The annealing department---Methods of packing the castings and charging the furnaces

BY RICHARD MOLDENKE

A FURTHER word in regard to the inspection of castings in the hard. As the molds are dumped, and later on the cleaning gang comes along, in large works at night, a rough separation of castings from the gates is undertaken. Cores are removed as much as possible, and in some cases with special core-rod pulling devices, for instance in the making of couplers or other long hollow work. Core rods, by the way, should be returned to the core room to wire straightening machines which operate better, cheaper and more effectively than the old hand straightening method. It even pays to put a pensioner watching the yard gates straightening the nails used.

The rough sorting will take out all the mis-runs, castings where cores may have been forgotten and other defective work which may be easily seen even at night. All this goes with the sprues, in well regulated work, to the big slag barrel placed outside the buildings, and preferably run by a motor from the light circuit of the plant. The sprues should be rolled clean. There is a disadvantage in using sprues just as they come from the foundry. The metal is protected from the melting action of the flame in the furnace longer than it should be. Then more slag is made, which in turn makes the heat longer, more skimming must be done, and dirtier furnaces and dirtier iron are the consequence.

Cleaning Castings.

The good castings, as far as this may be seen, now go to the hard rolling room, or tumbling room as it is oftentimes called, to be cleaned there. This room is usually the bane of the works. When one has say 60 of the rumblers usually employed in full blast, no dust exhaust, one can neither hear nor see, the electric lights simply glow as if in the dim distance, and no one stays there longer than he can help. This, however, is the very reason why attention should be given the department.

To roll a casting longer than just enough to remove the sand by the hard stars placed in the barrels, and the contact of the castings with each other, is a waste of power and equipment. About 20 minutes seems to give good results under ordinary circumstances. However, at times the sand is so badly stuck to the castings, especially the heavy ones, that it practically forms an enamel on them. Rolling all day will only polish the work instead of cleaning it, and hence attention should be given the sand to see that it is free from too many fluxing impurities, and particularly the iron as it comes from the furnace, which may be badly oxidized through over-heating, or holding too long, getting "high."

The difficulty with sand burnt to the casting is usually seen when there is trouble with dull iron. A heat is sometimes kept in long after its proper time for tapping has passed, to get it hotter to pour well. This holding in the furnace allows the metal to slightly oxidize, the melting point is raised considerably, and while appearing extremely hot when tapped, the ladles "skull," and the castings are mis-run. Usually, in such cases,

the sand trouble is noticed. The temperature of the metal was simply too high for the sand, and some of it fused to the casting. Considerable hand or air-chipping then becomes necessary for proper cleaning.

The hard rolling room crews must therefore be carefully watched to see that the charges of castings are removed when rolled sufficiently, and taken into the trimming room, where they are gotten ready for the anneal while being carefully inspected at the same time. The present practice of using exhaust tumbling barrels is doing much to make this department of the malleable works a habitable place, and incidentally cutting down the rolling cost. The stars placed in the barrels are made of the same metal as the regular castings, and the molding is generally part of an apprentice's work.

Pickling Castings.

From the nature of the metal in the hard, heavy castings cannot be rolled with very light and fragile ones without danger of breaking them. It is oftentimes necessary to separate large castings, in fact wedge them into the barrels with sticks of wood, so that they may not move, but allow the stars and other plain castings to tumble about them and thus do the cleaning. Light and fragile castings may not be rolled at all, but are pickled. This may be accomplished in two ways. With sulphuric or hydrofluoric acid, or by means of the sand blast. The advantages of the sulphuric acid pickling bath are its cheapness and ease of manipulation. Mixed about 30 to 1, or sometimes a little stronger, the light castings are preferably laid on a series of perforated inclined wooden shelves, and the fluid poured over the top. It trickles down over the castings on all the shelves, and runs back into the vat again. The night watchman, in going his rounds, or preferably the night annealer, keeps this up during the night, and next morning the castings are washed down with the hose, and go to the annealing room. Another method is to simply let the castings remain in the pickling vat, which may be heated by a steam jet, taking them out when clean. The disadvantage of the sulphuric acid pickling bath, is that it dissolves iron and not the sand adhering to it, so that it really makes the sand scale off. Further, it emits a bad odor. Where pickling is done for galvanizing purposes, a second bath of hydrochloric acid is sometimes provided after the sulphuric acid pickle, which cleans the iron still better and gives the zinc a good hold on the surface of the metal.

Use of Hydrofluoric Acid.

Hydrofluoric acid has the advantage of dissolving sand and not the iron. If heated, the pickle can be 1 to 50, and fine results are obtained. Like the sand blast, it shows up the surface imperfections very strongly, and has the disadvantage of being poisonous to a degree. It must be handled with rubber gloves when full strength, but is all right when diluted in the pickle. The author at one time used two large wood tanks with a lead steam siphon, so arranged that the liquor of the pickle could be forced from one tank into the other at will. Twenty-five tons of small castings were pickled daily, and the cost was no larger than for rolling. Inconvenience of location caused the experiment to be stopped at the time, but one interesting feature was noticed. After washing the castings thoroughly, they would rust very quickly. In the meantime, the liquor siphoned into the other tank was cleaning the next day's batch of small castings. Now these rusty castings when duly annealed, would be dumped out of the pots without having the scale adhere to them, and most of them were shipped without being soft-rolled. They had a beautiful blue to black surface, and after chipping, grinding, or straightening, could go out thus with credit to the works.

Sand Blast.

The sand blast is just beginning to find its way into our foundries. In Europe, cleaning by this method is further advanced, notably in the stove shops. Nevertheless it is an excellent way of cleaning castings, and has come to stay. Rolling barrels can be arranged to have the sand forced into them while revolving, and if the castings can turn in all directions, they will be thoroughly cleaned.

When the castings come from the tumbling barrels, either by wheelbarrow or overhead trolley, they go to the trimming room tables where the sprues are chipped off with the hammer, they are sorted and gathered according to the shop orders on file there. This is one of the most important departments of the work. Not only can much subsequent grinding and chipping of the soft castings be done away with here by proper trimming off the comparatively easily broken hard metal, but the reputation of the works can be kept high or poor by the vigilance of the trimmers and inspectors. Any "jacking up" that may have to be done by the president of a concern when he finds complaints about the appearance of the work coming in, is done here, for the works management is apt to shut an eye to poor looking work, so long as the castings are sound. Furthermore, as all the castings are counted and weighed here, the discount is determined, subject to an addition before the finished castings leave the warehouse. From here the reports go to the shop office, and what goes into the anneal is known day by day in preparation of the shipments on orders.

Inspection.

Another good feature which should not be omitted in this department, is the gathering of the rejected castings into piles for the inspection of the molders during the noon hour. A man doing piece work has the right to see the castings he will not be paid for. Moreover, this gives an opportunity for the foreman to go over some of the molding problems with the men, as it is not a desirable thing to melt iron for scrap, nor to lose any more floor space for paying work than possible.

Annealing Department.

From the trimming room after inspection, the castings go to the annealing room. This department has its floor space divided into two portions. The packing floor, and the ovens. In the most advanced cases, where the ovens are dropped into the ground, and are practically soaking pits, a traveling crane doing the charging and discharging, the packing floor is at one end of the room, and the ovens proper at the other. In the older works, the ovens are usually in two rows, one on each side of the building, and the clear space between is used for the packing of the pots and manipulating the charging trucks, or else the ovens are on one side only and the other is used for the packing.

The floor of the annealing room, where the packing and trucking are done, is covered with 1-inch iron plates. These are cast as required, for the constant pounding on them, and the effect of the heat tends to warp them badly, as well as breaking many. A floor of this kind withstands exceptionally hard usage. The annealing boxes or pots, also called "saggers," are heavy containers, either

square, round, or more usually oblong. When first cast, they are about 1-inch thick, with proper draft for the pattern. As they are used over and over again, if not broken the first time, being white iron they become thinner through the scaling-off of oxidized metal, and finally becoming too thin, they are scrapped. These pots are piled three and four high, and placed on a stool of iron, so that when luted up with mud, and similarly covered with this material, (which is simply burnt sand from the rolling room mixed with water, and perhaps a dash of fire clay) or an iron plate, where particular care is to be taken, they make a more or less air tight receptacle for the castings packed in scale.

The scale used for the packing is more usually the cinder squeezed out of the muck balls where wrought iron is made. It is very rich iron slag, a silicate, with a lot of iron shot and small lumps in it. As this material is used over and over again, it becomes mixed with the flakes from the pots, (which is the best material for annealing purposes when properly crushed), and gradually the scale pile becomes a more or less rich oxide of iron. This was formerly sprinkled daily with a solution of sal-ammoniac to "rust" it, and thus a nice little pile of money was thrown away yearly. Cast or steel borings are also put into the scale, but if at all salable this process is a waste. The flakes from the pots, in all the older works, will be found to have made excellent roads around the premises, whereas the author, after purchasing the first batch of scale in the market, never bought any thereafter, the crushed flakes of the pots replenishing the supply, and necessitating an occasional screening to reject the fine powder, which through mixture with remaining sand on the castings burns on in the anneal.

Filling the Pots.

As the castings come into the annealing room, the operator places a pot on one of the stools, shovels in some scale, and lays the castings into this in regular order with scale to surround them, hammering the pot all the while to shake down the scale and tightly pack the castings. This to prevent warping as much as possible. The heavier classes of work are distributed in such a way that instead of bearing down on the smaller ones with their weight under the intense heat of the anneal, they rather support the whole structure. Many times, with flat work, it is not necessary to put scale between a batch of castings. Long flat castings are placed upright, to remove the tendency to bend, and oftentimes, with brake rods, it is necessary to build up the boxes very high. The essential principles to observe are that no opportunity is given the mass to settle down and thus warp all the castings within the box, unless this settling is brought about by excessive heat ruinous to the castings, and to allow no chance for air currents to pass through the pots either through imperfect luting or settlement due to loose and careless packing. In the latter case, the work will be badly scaled away. Sharp corners will be rounded off to the disgust of the customer, or whole patches of the surface may lift off, and a very undesirable state of affairs will exist.

Scale.

This scale is, however, not the only material for packing purposes. Hematite ore is much used, especially where cupola iron is the rule, and higher temperatures for annealing must be resorted to. More recently a very fine material has come in, and consists of magnetite from the Adirondack regions. This breaks in grains, and when sized to about a split pea, is just what is wanted for annealing work.

Intrinsically, however, sand and brick bats would answer for packing purposes, the real change in the castings being the conversion of the combined to an annealing carbon called "temper" carbon—by the late Prof. Ledebur, of Germany. This change is brought about when conditions are correct as required by the malleable process for the "black-heart" castings made in this country, and practically any kind of packing may be used to protect the castings from the burning of free gases and excessive heat.

Castings Packed in Fire Clay.

A number of tests on malleable castings annealed in the regular way and in fire clay, showed that when a packing is used that will not allow the carbon in the skin to migrate out and burn away—as it can in scale and ore—then the tensile strength of that casting is reduced by several thousand pounds per square inch. Hence it would not seem advisable to change from the ordinary method of work. When the skin was planed away, and the interior of these rather heavy test pieces subjected to the tensile test, the results practically agreed, and were not very much lower than the bars with the skin left on. This is stated here merely to off-set the claim occasionally made that the interior of a malleable casting might as well be thrown away as the skin is the only strong part of it. Evidently the authors of such statements must have had in hand test bars, the centers of which consisted of a succession of heavy shrinkages. Normally made malleable castings should not show this to so serious an extent.

Charging the Furnaces.

The pots duly packed and luted up, then covered with a coating of mud or an iron plate also luted tight, are now placed in the annealing ovens in regular rows with about four inches between them for proper circulation of the gases carrying the heat. The ovens are luted up and the firing commenced. This charging was formerly done entirely by hand operated trucks, the forks of the truck passing under the stool, and raising it by a lever arrangement. Then a gang of men got behind and the pot was rushed into the oven in its proper place.

BICARBONATE OF SODA AS A DEOXIDIZING AGENT.

In a patent recently granted, the use of bicarbonate of soda as a deoxidizing agent in copper alloys is recommended. It is claimed that in casting copper or copper alloys the presence of oxide of copper tends to prevent the attainment of a perfectly even structure of the casting. For the same reason its has hitherto been impossible to add copper or its alloys to iron or steel in large, or at least in such quantities as to impart to the metal greater hardness or strength of resistance than that of the ordinary alloys. In order to permit the addition of iron, the assistance of other metals such as zinc, aluminum or nickel has been requisitioned, which act, to a certain extent, as carriers for the iron. The method outlined by C. Gautsch consists of adding to the metal, copper or mixtures of copper, tin, old metal or iron, steel or the like, besides the usual addition of phosphorus, a suitable quantity of bicarbonate of soda, part of which can be advantageously added at the commencement and a part after the metal has been melted. The amount of bicarbonate of soda added may vary from 1 to 0.40 per cent. It is claimed that the bicarbonate of soda causes the mass to foam and produces an intimate mixture while the oxides of copper pass into the slag.

THE USE OF VANADIUM IN CAST IRON

Action of this metal on gray iron for casting purposes and methods of application in the ladle and air furnaces

BY J. KENT SMITH*

CAST iron may be regarded as a more or less impure steel, containing, in addition, the nonmetallic elementary constituent graphite, interspersed in granules, flecks, or plates throughout its structure; this graphite, aside from any consideration of the proportion of the other elements, renders the iron unadapted to hot working in order to effect change of shape. In addition, the continuity of the metal is destroyed; hence the "limit of strength" of cast iron is reached very soon, as compared with the "limit of strength" of steel, from which it will also logically follow that any improvement conferred upon cast iron by an alloy must necessarily not give such spectacular laboratory results as in the case of steel. Nevertheless, vanadium can and does impart such properties to cast iron as to almost revolutionize the material.

Vanadium.

Vanadium is a readily oxidizable metal, which, at the heat of molten iron, readily decomposes oxide of iron with a resultant vanadium oxide which is readily fusible and at once passes away in the slag. Vanadium is also one of the very few elements which is capable of forming a stable nitride, which body is also easily slagged away. Hence, as a scavenger alone, vanadium is of remarkable value, as by the elimination of the poisonous oxide and nitrogen contents, the metal is made to assume a well-packed structure, which, as far as its metallic particles are concerned, is of a strongly coherent nature.

It is to be noted that in scavenging by means of vanadium, the necessary equivalent amount of vanadium is removed from the metal by the slag, and it must follow, therefore, that with a certain amount of vanadium added, more or less will be found in the residual metal according as the amount of cleansing work will have been large or small.

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In the second stage, vanadium somewhat strengthens iron by its solid solution in the carbonless constituent of that iron, rendering the molecules of its constituents more coherent than ever, and their crystals more resistant to abrasive wear and less susceptible to breakage or disintegration along their cleavage lines.

In the third stage, vanadium strengthens directly by its action upon that constituent of cast iron which contains the chemically combined carbon.

From all this it will be seen that it would be ridiculous to attempt to designate by any single figure the augmentation which would result in, for example, the tensile strength of cast iron as the result of the addition of a definite amount of vanadium, both on account of the cleansing work to be done and of the "basic" constituent nature of the iron in question.

Tensile Strength.

The following examples, taken at random from laboratory figures, may be taken as demonstrating this point:

A cylinder iron having a tensile strength of 26,000 pounds, by the addition of 0.22 per cent of vanadium had its tensile strength increased to 37,000 pounds per square inch.

Another cylinder iron having a tensile strength of 23,000 pounds, by the addition of 0.22 per cent of vanadium had its tensile strength increased to 32,000 pounds per square inch.

A very high grade of special iron having a tensile strength of 30,000 pounds, had, by the addition of 0.15 per cent of vanadium, its tensile strength increased to 33,000 pounds per square inch.

Instances are available of very poor iron which had a tensile strength of about 12,000 pounds to the square inch, which, by the addition of 0.22 per cent vanadium (almost entirely used up in scavenging), had their tensile strengths increased to about 20,000 pounds to the square inch.

In transverse strength the benefit derived from the addition of vanadium is somewhat more marked in many cases. Taking as a basis for figuring the transverse load required to produce rupture of a 1¼-inch diameter bar, supported on rests 12 inches apart, the following figures may be quoted from among many of the tests.

A poor cast iron, without vanadium, broke at 1,300 pounds.

The same iron, with vanadium, broke at 2,200 pounds.

Another, without vanadium, which broke at 1,400 pounds, after the addition of vanadium, required 2,100 pounds to break it.

Cupola iron, which normally broke at 2,500 pounds, as a result of the addition of 0.15 per cent of vanadium, broke at 3,400 pounds.

A somewhat similar iron, without vanadium broke at 2,700 pounds, and after the addition of vanadium required 3,400 pounds to break it.

A high grade air furnace stock, which normally broke at about 3,700 pounds, after vanadium, withstood a transverse breaking load of 4,200 pounds.

An extraordinarily high grade air furnace stock, which normally broke at 4,000 pounds, as a result of its containing 0.13 per cent of vanadium, broke at the high load of 4,400 pounds.

Deflection.

The added strength was not obtained at the sacrifice of deflection figures, the irons mentioned in the last two cases having a deflection figure of 0.145 inches in each case. In the other tests exact deflection figures are not available, but in each case the deflection before rupture was very marked.

Compression.

The value of the vanadium iron in resisting compressive loads is well marked.

A sample of high quality iron, which normally resisted 135,000 pounds per square inch compressive load before rupture, had its com-

pressive resistance raised to 150,000 as a result of the addition of 0.18 per cent vanadium.

A somewhat harder iron, having a compressive breaking load of 146,000 pounds, as a result of the addition of 0.18 per cent vanadium had its compression strength raised to 161,000 pounds.

A sample of chilled iron, which normally withstood a compressive load of 217,000 pounds, as a result of the addition of 0.15 per cent vanadium, required the application of 251,000 pounds to the square inch to cause its rupture by compression.

Hardness.

It has been contended by some that these increases of strength are obtained at the sacrifice of softness of the iron, and with the object of proving the erroneous nature of such statements in the case of vanadium, the following tests were undertaken:

Air furnace iron, which gave a Brinell hardness figure of 187 showed, as the result of the addition of 0.20 per cent vanadium, a hardness figure of 196.

In another test a similar iron, with a hardness numeral of 188, showed, as a result of the addition of 0.22 per cent of vanadium, a hardness numeral of 191.*

Wearing Quality.

That resistance to abrasive wear cannot be deduced from hardness figures, or vice versa, is a fact which is now well recognized. A little consideration will at once render it evident that the degree of toughness, combined with the hardness, must make a vast difference in the quality of resistance to wear. Unfortunately no well standardized test has as yet been devised to enable us to record, with the same degree of numerical precision as is available in our records of tensile, transverse and compressive strengths, the quality of a material for resisting loss by abrasive or rolling wear. As a result it is necessary to go to service records for a substantiation of the assertion that one of the most valuable properties conferred by vanadium on cast iron is the resistance to wear which can logically be deduced from the introductory remarks of this article.

A locomotive valve cylinder bushing of vanadium cast iron, which had been in exigent service for 22 months, on examination, showed no signs whatever of abrasive wear, the original tool marks being still in evidence.

Automobile cylinders of vanadium cast iron have been found to resist internal wear to a degree highly superior to those of ordinary iron, and to assume a mirror-like internal polish which has been found of great efficacy in service.

Resistance to Wear of Chilled Iron.

In chilled iron, the resistance to wear due to the incorporation of vanadium becomes still more marked. A pair of chilled iron rolls, made from air furnace stock, with the addition of 0.22 per cent of vanadium, showed, the writer is informed, a wearing life three times that normally incident to the ordinary iron rolls made from "straight" iron made by the same firm. The importance of this statement it would be hard to exaggerate, as not only does it mean that the upkeep per ton of material rolled is reduced by two-thirds, but as the rolls required such infrequent dressing and were evenly worn, the percentage of prime quality sheets rolled was greatly in excess of that common to the same sheet mills using ordinary rolls, the percentage of seconds or wasters being correspondingly decreased.

It might be well at this point to lay stress upon the fact that it is particularly necessary to guard against the presence of internal strains in such an article as a chilled roll, otherwise the life of such a roll is terminated by breakage long before the period of wearing life is run, but the avoidance of such strains is a question of good foundry practice simply and solely, and should be followed with equal care in all classes of chilled rolls.

Effect on Depth of Chill.

The question naturally arises as to whether vanadium has any effect upon the depth of the chill. That it has some effect is certain, but as in the data before recorded it is not possible to fix an arbitrary figure for all combinations of circumstances. It has been observed, however, as a result of close watching, over a considerable period, that in air furnace work, iron containing approximately 0.9 to 1 per cent silicon, 0.5 per cent manganese, 0.4 per cent phosphorus, 0.05 per cent sulphur, 0.55 per cent combined carbon and 2.6 per cent graphite, the addition of 0.22 per cent of vanadium, (resulting in the remaining in solution or combination of 0.16 per cent of vanadium in the iron), causes the chill to strike in a further 10 to 15 per cent.

In a harder iron, such as car wheel iron, where the silicon only approximates 0.5 to 0.6 per cent, the addition of a small amount of vanadium was observed to throw the chill in still more, the approximate figure observed being about 25 per cent increase.

Therefore, in foundry practice, in the preparation of chilled vanadium iron, provision should be made to offset this difficulty, either by increasing the silicon in corresponding amount in vanadium iron, or by substituting a metal chill in the mold of the required lesser degree of intensity demonstrated in the particular case.

Shrinkage.

Vanadium being allied, in a somewhat modified form, to the members of the aluminum family, naturally somewhat increases the shrinkage, but for all practical purposes such increased shrinkage is so small that it may be neglected in the foundry; in all the commercial work which has been done with vanadium cast iron, it has never been found necessary to change in any degree the pattern measurements with regard to this aspect of the case.

Method of Application.

Vanadium is available for commercial use in the form of ferro-vanadium, an alloy containing approximately two parts of iron and one of vanadium; a portion of the iron may be replaced to some advantage in some circumstances by an equivalent amount of silicon. Such an alloy has a fusing point intermediate between those of cast iron and steel, and is readily soluble in molten iron.

For the addition of vanadium to cupola iron, two courses are available:

First.—The necessary amount of ferro-vanadium, calculated from the vanadium contents of the alloy, required to vanadize the iron desired, is dissolved, in a moderately finely divided condition, in about five times its weight of pig iron which has previously been melted in a crucible. About 30 minutes suffices for this solution in a hot fire. The iron is tapped into the foundry ladle, and, simultaneously, the vanadium iron solution is introduced into the ladle and well rabbled.

Second.—The ferro-vanadium alloy

*These hardness numerals can be considered as practically identical, as the extreme limits between the hardest and softest figures quoted only show a variation equivalent to one-tenth of a millimeter width of depression, which measurement can be considered as practically within the limits of normal observation in such a test.

is finely powdered, so as to pass a sieve of about 10 mesh. At the time of tapping the cupola a little ground ferro-manganese, in quantity equal to about 0.24 per cent of the iron to be vanadized, is added in finely ground form to the stream issuing from the spout, and the necessary amount of ground ferro-vanadium is added at the same time. The contents of the filled ladle are immediately transferred to another ladle of similar capacity to insure incorporation; after this, pouring is performed as usual.

Application in the Air Furnace.

If the air furnace be in question, the mode of operation is extremely simple, though, of course, either of the methods previously mentioned can be resorted to. The charge is melted down as usual, and about 30 minutes prior to tapping ferro-manganese, to the amount of ¼ of 1 per cent of the contents of the furnace, is introduced in small nut size, and is well rabbled through the bath to cleanse it. The necessary amount of ferro-vanadium, similarly sized, is then introduced and worked through the bath with a wooden pole. In 20 minutes or so incorporation should be fully completed, after which the furnace may be tapped and the metal poured as usual.

It need hardly be emphasized that in order to obtain the best results, all practice incidental to good foundry practice must be rigidly followed, as it would be utterly illogical to expect any alloy, which gives definite metallurgical attributes to the iron, to render it permissible to neglect or evade those practical precautions which have nothing whatever to do with purely metallurgical reasons.

Porosity Troubles.

The service record of chilled rolls, valve bushings and cylinders have already been particularized. The question of the elimination of porosity has only been briefly alluded to. A letter just to hand from a large consumer of small cylinders makes the authoritative statement that, where their ordinary rejections of cylinders of plain iron amounted to 65 per cent on certain work, the adoption of vanadium alloy in the preparation of the same cylinders resulted in the acceptance of such cylinders, none being rejected for mechanical defects. Porosity had been a particular source of trouble, and the vanadium alloy had entirely eliminated it.

CONVENTION OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION

THE annual meeting of the American Foundrymen's Association and allied bodies, including the Foundry and Manufacturers' Supply Association, the American Brass Founders' Association and the Associated Foundry Foremen, will be held in Cincinnati the week of May 17. Secretary Richard Moldenke, of the American Foundrymen's Association, has fixed the meeting days of this body for Tuesday, Wednesday and Thursday, May 18, 19 and 20. Headquarters will be established at the Hotel Sinton, and announcement regarding railroad rates and hotel facilities will be made later.

MUSIC HALL, CINCINNATI, WHERE THE EXHIBIT OF FOUNDRY SUPPLIES AND EQUIPMENT WILL BE HELD DURING THE CONVENTION OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION

The exhibit of foundry equipment and supplies to be held in Music Hall, will be conducted under the auspices of the Foundry and Manufacturers' Supply Association and will continue throughout the entire week. This hall affords exceptional facilities for the display of foundry machinery and equipment, the first floor containing about 27,000 square feet, while the area of the second floor is 14,000 square feet, which will probably be devoted to still exhibits. In addition it is the present intention to erect a temporary building adjoining the hall, for the installation of furnaces for melting iron and the softer metals, which will be cast into molds made on the molding machines that will be shown. Inquiries for space should be addressed to C. E. Hoyt, secretary, care Lewis Institute, Chicago.

Many manufacturers have already applied for reservations, and from present indications the exhibit will surpass anything before attempted by this organization. Improvements in molding machines and foundry equipment have been numerous during the past year and in many lines of foundry work, practice has been almost revolutionized. All of the latest appliances and devices will be displayed and every foundryman should avail himself of this opportunity to witness the practical demonstrations of machines that have made possible the rapid strides that have been recorded in foundry work during the last 12 months.

In his announcement to the members of the various foundry organizations, Secretary Richard Moldenke makes an earnest request for papers on practical foundry work for presentation at this meeting. Suggestions for subjects for discussion are also desired and if received in ample time before the convention, these topics will be assigned to speakers who are thoroughly conversant with the work.

An interesting program is also being outlined by the American Brass Founders' Association, whose meetings will probably be held apart from those of the American Foundrymen's Association. The entertainment features will fully measure up to the hospitality for which Cincinnati is noted, and the visiting foundrymen and their ladies are promised an enjoyable week.

A MACHINE FOUNDRY FOR SPECIAL WORK

Methods pursued in the new plant of the General Electric Co., where molding machines are used exclusively---Interesting arrangement of floors and sand conveying equipment

AT THE new foundry of the General Electric Co., Pittsfield, Mass., the manufacture of transformer boxes on molding machines is being carried on under surroundings and with equipment designed particularly for this class of work. These boxes constitute close to 90 per cent of the entire output of the machine foundry, and the fact that activities can be so largely centralized on this one line affords unusual opportunities for the practice of economies which are resulting in a production surprisingly large in comparison with that obtained by floor molding.

Transformer Box Molding Machine.

The largest transformer box turned out is molded on a special machine having a 36-inch draw, and the preparation of this mold is naturally a difficult undertaking, owing not only to its size and proportions but also to the extreme thinness of the walls, which nevertheless must be cast absolutely perfect, as each box is submitted to a severe hydraulic test before it is accepted. When these were produced on the floor, three or four molds was the customary output for a gang of one molder and two helpers. At the Pittsfield plant one machine operator, with a helper, can turn out 12 molds per day, so accurately made that the loss through rejected castings has been brought down to under 5 per cent. When it is considered that this mold, aside from the difficulties incident to its preparation, is of such shape that the pouring operation is particularly hazardous, owing to the large volume of gases to be taken care of, these results are indeed remarkable.

In this transformer box work, special Pridmore machines are exclusively employed, there now being 16 of the type illustrated in Fig. 7, ranging from 14 x 14 inches with a 16-inch draw to 36 x 36 inches with a 36-inch draw. The largest machine, which is the one illustrated, is noteworthy because of its unusually long draw. In installing these machines the plan was adopted of mounting them on platforms supported by steel framework at such distance below the foundry floor that the top of the machine is brought practically down to the level of the floor when the pattern is drawn. An unusually high basement renders this possible without any interference in that direction.

Machine Installation.

This arrangement is clearly illustrated in Figs. 5 and 6, the former showing the pattern of a large transformer box on the machine with the pattern up ready for molding, while in the latter the pattern is drawn. The machine is controlled by a hand lever

FIG. 1—GENERAL VIEW OF THE PITTSFIELD, MASS., FOUNDRY OF THE GENERAL ELECTRIC CO. THE PHOTOGRAPH WAS TAKEN AT NIGHT. THE PLANT IS LIGHTED BY SIX FLAMING ARC LAMPS

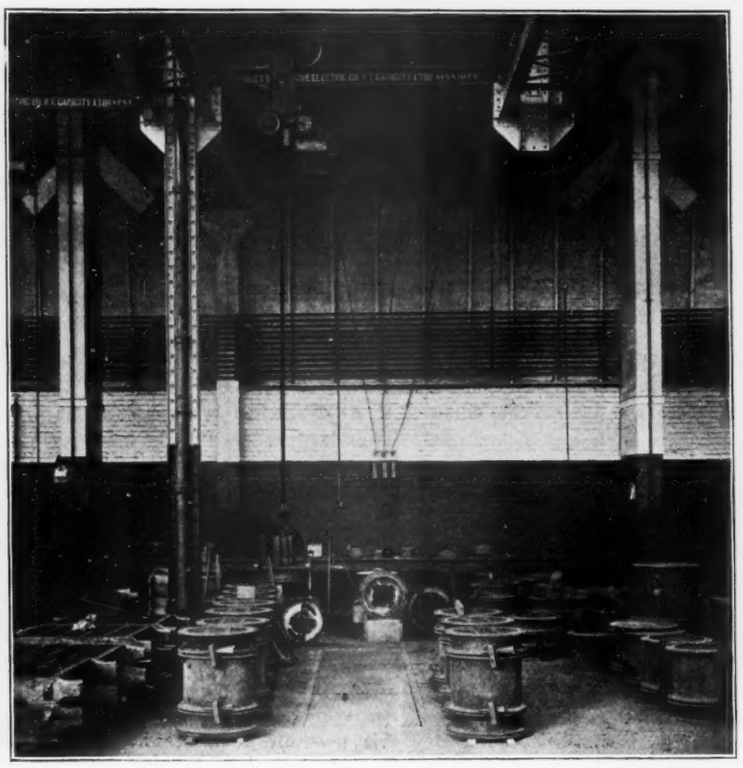


FIG. 2—VIEW OF ONE OF THE FLOORS, SHOWING SAND CONVEYORS AND CHUTES, AS WELL AS MOLDING MACHINE IN THE BACKGROUND

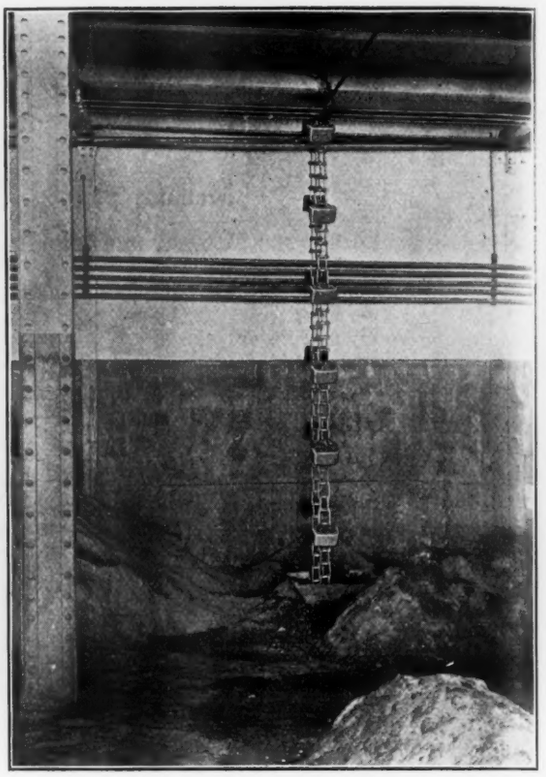


FIG. 3—SAND CONVEYOR IN THE BASEMENT UNDERNEATH THE MOLDING FLOOR

located near the floor and connected with the ordinary controlling lever shown near the base of the machine shown in Fig. 7 This arrangement has been found an extremely convenient one, as it reduces the hoisting distance necessary in removing the mold, affords a larger degree of safety to the pattern and possesses other important advantages, among them the increased amount of space provided for other purposes to which the floor is put. On all this work these flasks are hand-rammed.

Arrangement of the Plant.

Eventually the plans call for a double foundry building at Pittsfield, one to be devoted entirely to floor molding and the other for machine molding exclusively. At present only the latter is complete and accommodates both departments. It is probable that the floor foundry will be built during the current year, thus completing the original design for the plant, as the core room, power and melting facilities now provided are ample for the two compartments. The floor foundry is to be identical in size with the machine foundry, from which it will be separated only by a brick wall some 12 or 15 feet in height. This is already in place, but above it the north wall of the present building is of a temporary nature.

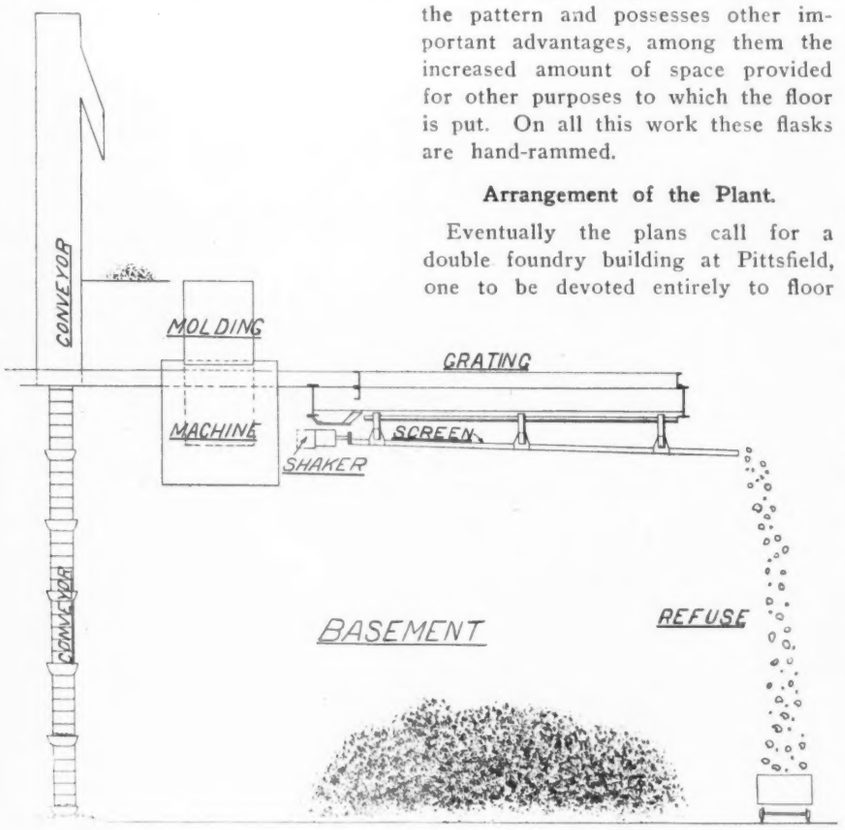


FIG. 4—ARRANGEMENT OF SAND CONVEYOR, MOLDING MACHINES, GRATING AND SAND SHAKER

The foundry building is of brick and steel, thoroughly fireproof, and measures roughly 150 x 360 feet. A 72-foot section across the eastern end is occupied by the core room; adjacent to this a 24-foot section provides toilet facilities on the foundry floor, the office and blower room on the second floor and the charging platforms on the third, with the cupolas at the center of the building; a space about 216 x 75 feet is arranged for machine molding; and the western end, 48 x 150 feet, is taken up by the cleaning and chipping department, with abundant room in the basement for any additional space required and for storage. Spiral iron stairways connect the various floors.

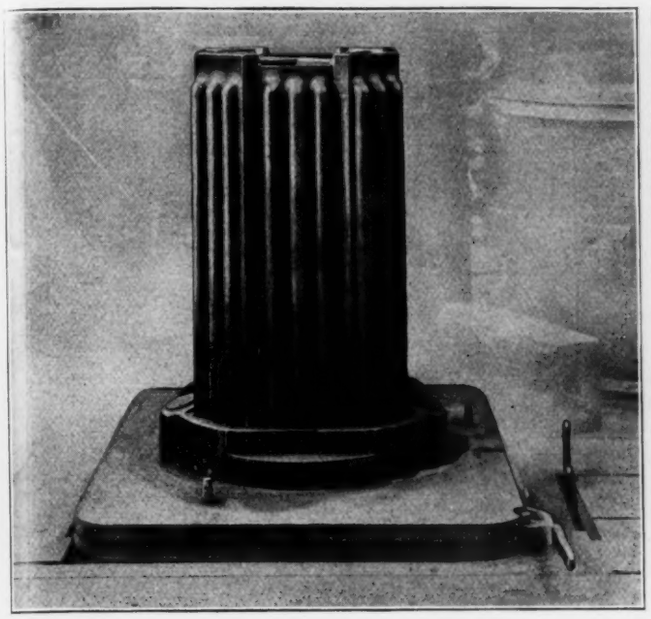


FIG. 5—PRIDMORE TRANSFORMER BOX MOLDING MACHINE. THIS VIEW SHOWS THE PATTERN IN MOLDING POSITION

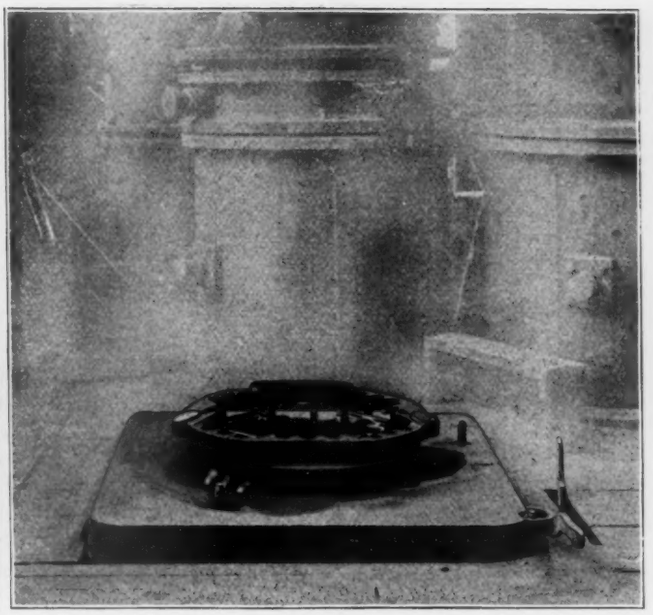


FIG. 6—TRANSFORMER BOX MOLDING MACHINE, SHOWING THE PATTERN DROPPED AWAY FROM THE MOLD

In addition to the special machines used in transformer box work, the equipment of this foundry includes some 18 pairs of miscellaneous Pridmore machines of the ordinary type and ten power squeezing machines, among them several of Tabor make and one recently built by the Bridgeport Foundry & Machine Co. One of the Ph. Bonvillain et E. Ronceray machines is also being installed.

Melting Department.

In the arrangement of the melting department, an excellent system of handling materials has been devised. Two Otis elevators are located at the extreme end of the cupola house for handling the industrial cars to and from the stock yard. On the charging platform two principal sets of tracks run the entire length, one terminating in each elevator shaft; near the elevators cross-over connections are provided and a little further along switches run to a third track between the two. There is also a fourth track running along the outer side of the platform from the elevators to the cupolas.

This arrangement absolutely eliminates the necessity of any rehandling of materials. The loaded cars come up one shaft, are pushed to the front of the cupola, relieved of their charge and shunted back over another track to the second elevator without confusion or interference. At the same time, when operations are not heavy the cupola can be served with only one elevator working; and there is also ample space for the storage of materials on the platform, though it is not anticipated that this will be found necessary except in emergencies. The charging floor is remarkably well lighted, glass forming a considerable part of the roof, and its walls are finished in a light color.

Cupola Operation.

The class of work produced at this foundry is such that the best results are obtained by operating the cupolas alternately, one through the morning from 7 to 12 and the other from 1 to 6 p. m. The cupolas are of the Whiting type, with 56-inch shell, brought down by double linings to about 34 inches, and have a melting capacity of five to seven tons per hour. From foundation to top of stack they are 62 feet in height, and the distance up to the charging doors is unusually large, in proportion to the diameter, in order to utilize the

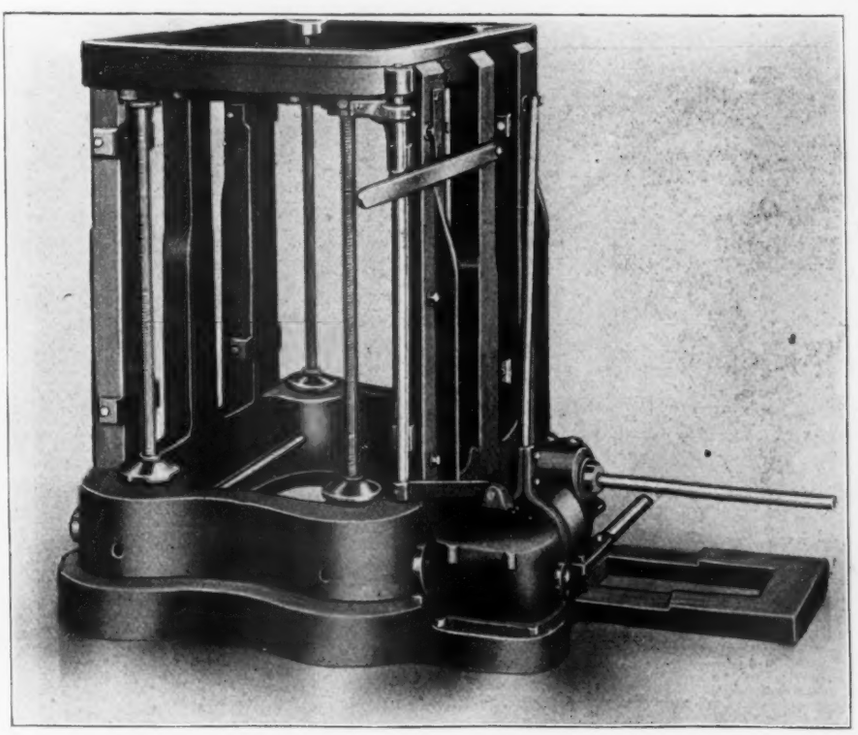


FIG. 7—PRIDMORE STRIPPING PLATE MACHINE, ESPECIALLY DESIGNED FOR MOLDING TRANSFORMER BOXES

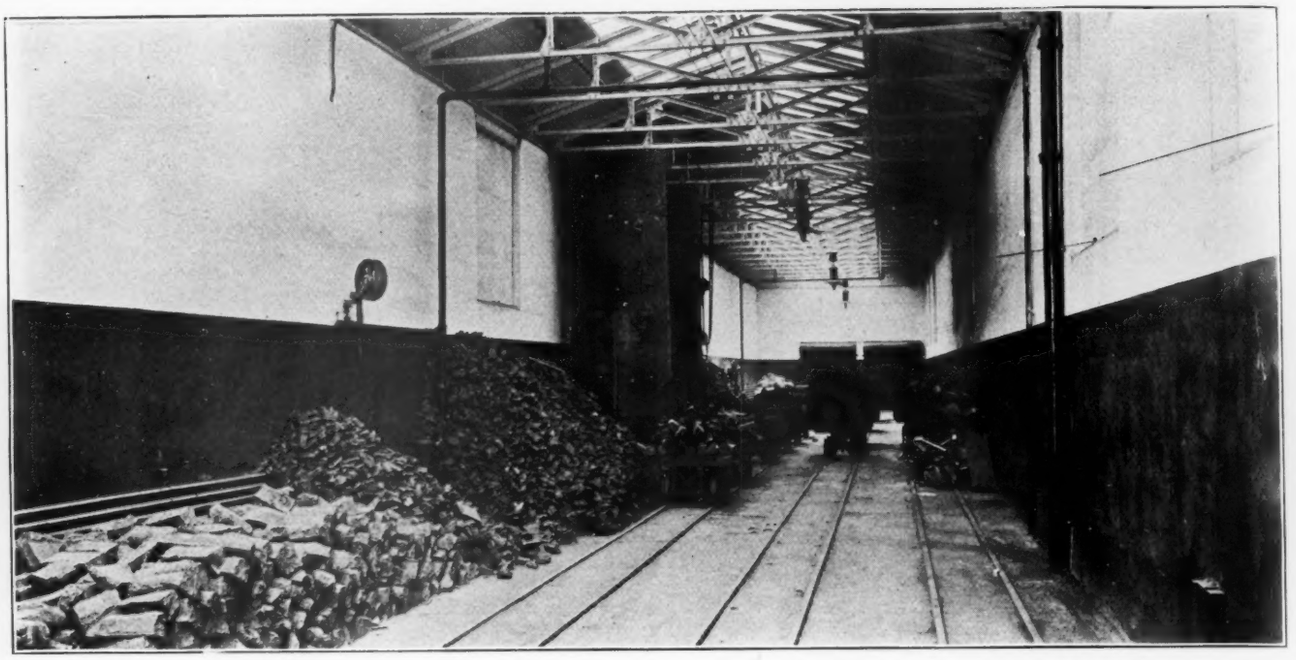


FIG. 8—VIEW OF THE CHARGING FLOOR

melting powers of the fuel to the greatest possible extent.

Blowers.

Immediately below the charging platform is a large room in the center of which the blower equipment is located. Either end of this room is given up to pattern storage purposes. The blower equipment includes two of the new General Electric centrifugal air compressors delivering a blast ranging from 0.88 to 1.25 pounds, one attached to each cupola. The compact form of this device, together with the fact that direct-connected motor drive is employed, allows the entire installation to be operated in extremely small space, as is made clear by Fig. 9, which also shows the large intake pipe and the slide in the pipe between the two blowers by which immediate connection with either cupola can be secured. The blower and storage room adjoins the foundry superintendent's office, from which numerous windows give an unobstructed view of the core room and pattern shop on one side and of the machine foundry on the other.

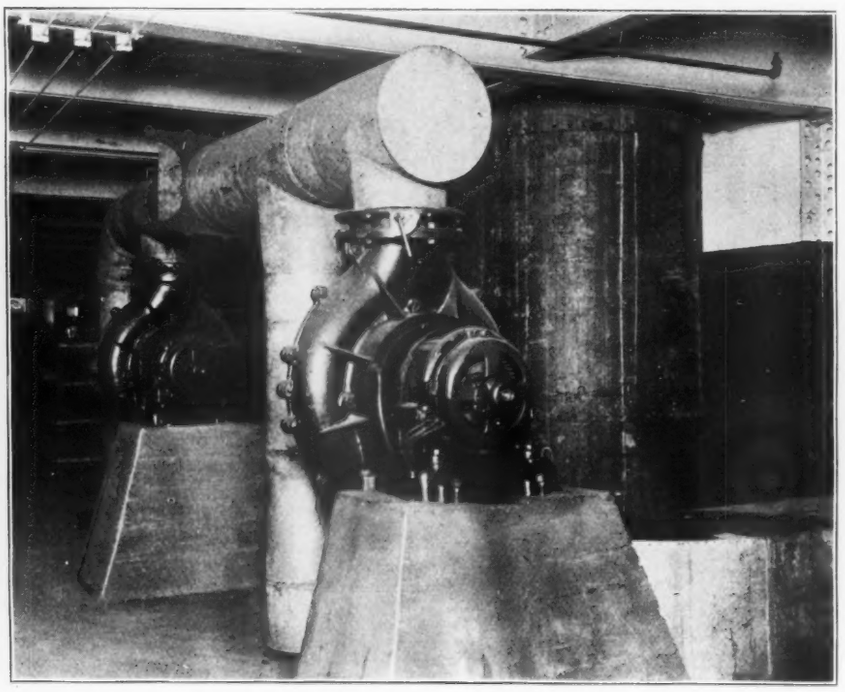


FIG. 9—VIEW OF THE BLOWER ROOM, SHOWING TWO GENERAL ELECTRIC DIRECT-CONNECTED AIR COMPRESSORS

Distribution of the Iron.

Buggy ladles on the double industrial tracks which run the entire length of the foundry convey the molten iron to the various floors where the pouring is done by a separate gang. This arrangement allows the molders to work continuously on their machines without interruption and makes it possible to develop an experienced pouring gang from which better results can be expected than under the ordinary system. Each floor is provided with its own traveling hoists, operating on runways crossing the foundry and controlled from the floor. Sprague electric hoists of 10-foot span are exclusively installed; 19 of these are of 1-ton capacity, two of 2-ton and one of 3-ton. This arrangement eliminates delays and other difficulty common where only a few heavier cranes are expected to perform this work. Fig. 2 shows the arrangement of a typical floor, with the hoist supporting the core and drag of a transformer box mold. The molding floor is laid with brick and contains the grated opening later referred to. The sand bench and enclosed conveyors are also seen against the wall.

Sand-Handling Equipment.

The fact that the foundry is so located as to allow a well-lighted basement of unusual height is taken

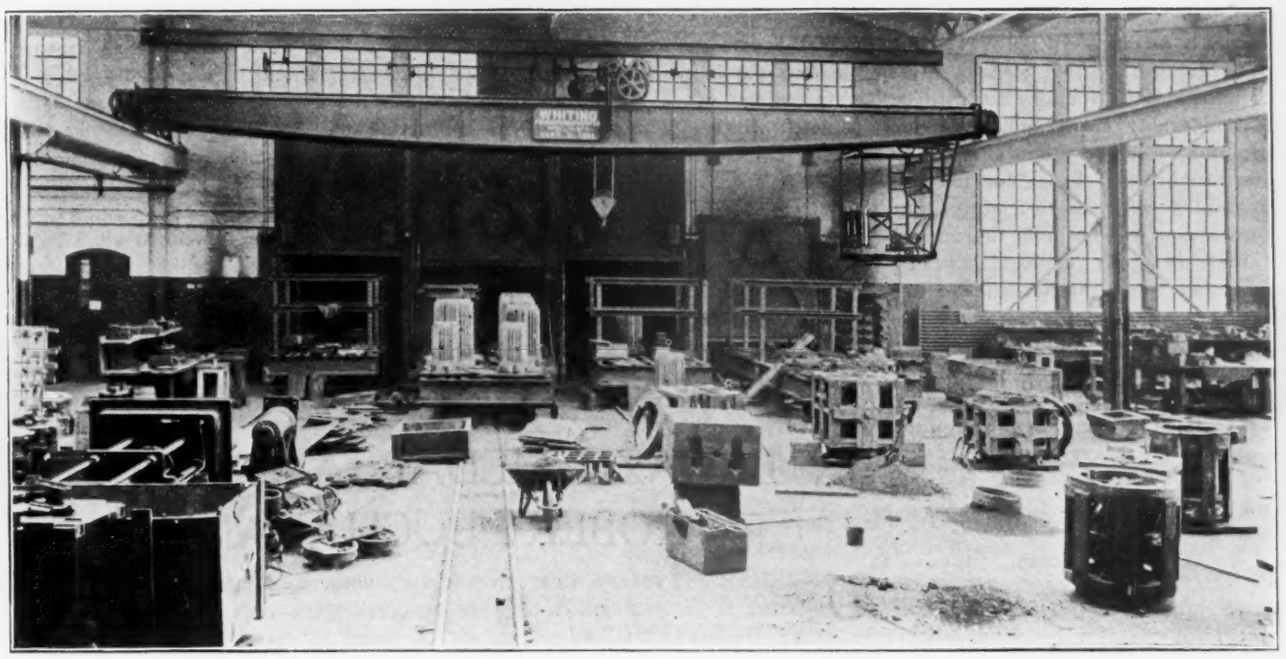


FIG. 10—CORE SHOP AND CORE OVENS WITH TRANSFORMER CORES ON ONE OF THE BUGGIES

advantage of in providing a unique system of sand-handling, which is as nearly automatic in its workings as is practicable and possesses other important features of merit. On either side of the industrial tracks running down the center, the foundry is divided into 18 floors for machine molding. As the practice of continuous pouring permits of important space economy, these floors are relatively small, about 12 x 20 feet. In effect, however, this space is materially larger as the floor reserved for the machine is immediately at the rear and is also available to a considerable degree, owing to the method employed of mounting the machines on a platform beneath the floor. Back of the machine, and against the wall, is a three-foot bench running down either side of the foundry.

The plant is designed for operation by gangs, one to prepare the molds, and another to pour and shake out. For facilitating the latter operation, each molding floor is in part made up of a rectangular grating, about 3 x 14 feet, located in the center of the floor and with its smaller dimension facing the industrial tracks. When the flasks are shaken out above this grating, the sand and finer refuse falls through to a suspended sand shaker some 3 feet longer and slightly wider than the grated opening. This screen is secured in such a manner as to permit of a limited motion, and is inclined at a slight angle toward the center of the building. At the upper end this is fitted to the arm of a Deane pneumatic shaker, the body of which is separately supported by a steel plate base solidly braced from the floor.

Screening and Tempering the Sand.

In operation, the sand from the flasks falls to the inclined screen and is shaken through it, while the small bits of iron and other refuse are carried over the end of the screen and deposited on the basement floor near an industrial track, ready for removal. Close to the wall at the rear of each grating a Jeffrey bucket conveyor runs from the basement floor to the top of the foundry proper. This conveyor is motor driven, control being located near the molding machine. When the operator is in need of sand, he starts the conveyor, thus signaling a laborer in the basement to shovel sand into a hopper feeding the buckets. The sand is already well tempered by reason of the distance it has fallen after passing through the screen; being sprayed as it accumulates. This work is furthered by shoveling sand into the conveyor and completed with absolute certainty by falling again from the

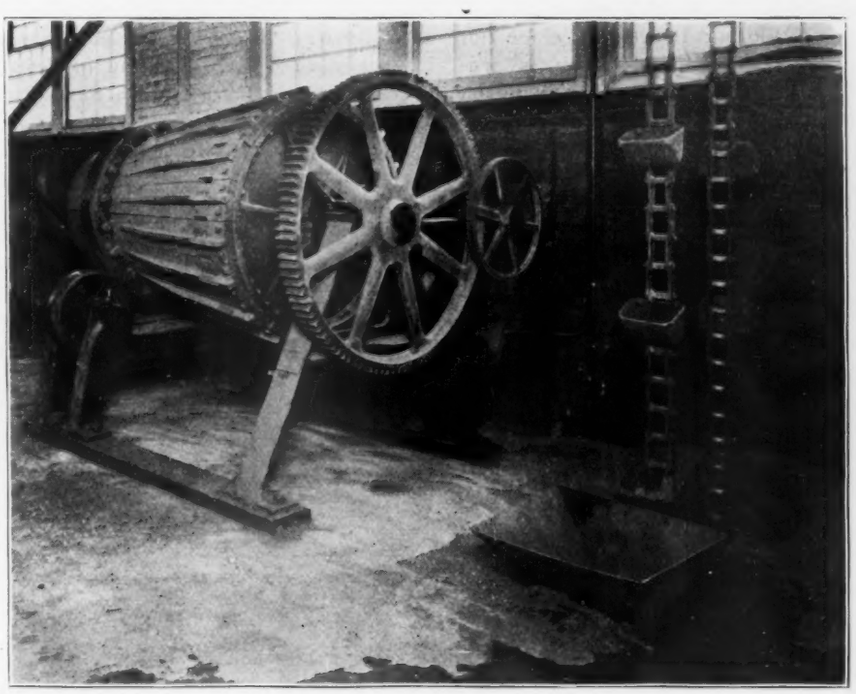


FIG. 11—SAND MIXER WITH SAND CONVEYOR IN THE BASEMENT OF THE CORE SHOP

buckets to the bench back of the machine, a distance of 10 or 12 feet. The advantages of this system, aside from allowing the foundry floor to be kept remarkably clean and free from obstruction, include the elimination of the usual labor charge for tempering, coupled with the certainty that this operation will be done thoroughly and that a supply of sand will be forthcoming whenever needed and out of the way at other times. Most important, of course, is the fact that by this circular method of sand handling, each machine is assured of an absolutely uniform grade. The design of this automatic shaker and the method of conveying the sand is well shown in Figs. 2, 3 and 4.

The Core Room.

Large bins are provided in the basement for the storing of additional supplies of sand, clay, and other material. A similar conveying arrangement prevails in the core room, but without gratings. There is a concrete floor in this department, on which the core sand, properly mixed with oil, flour, etc., is deposited ready for use as needed, spouts being attached to the conveyor at the top for its discharge. The sand mixing room for the core shop is equipped with a mill for preparing the core sand, shown in Fig. 11.

A general view of the core room is given in Fig. 10. It is provided with four large ovens, each 8 x 20 feet, and two small ovens, all of which are heated in the usual manner. These are served by 48-inch tracks, and a 3-ton Whiting traveling crane of 48-foot span and 15-foot lift is provided to handle cores from the oven cars to the tracks leading to the foundry and vice versa. In the illustration a number of transformer cores are shown on the car in front of the ovens.

Lighting Facilities.

Perhaps in no respect is this foundry more remarkable than in its lighting facilities, as is evidenced by the fact that the general view, shown in Fig. 1, is from a photograph taken at 10 p. m., with no other light than that furnished by six G. I. flaming arc lamps. These are 12 amperes, 2-in-series on 110 volts, 60 cycles; the globes are 16 feet from the floor and the lamps are 35 feet apart, yet they give perfect illumination to a space 75 feet wide and 264 feet long. Even on the darkest days, however, no artificial light is required, as generous skylights are provided, window space is made as large as possible and the brick walls, above a low wainscoting of a dark color, are painted white. The same style of finish is employed throughout the foundry, even in the sand pits in the basement, as shown in Fig. 3, and on the charging platform, Fig. 8, where this feature in connection with the large glass area in the roof, produces an extremely attractive effect. The extensive use of concrete floors wherever possible, and, in other places, of brick floors, renders it easy to clear away accumulations of rubbish and refuse. The time-honored theory that the foundry cannot be rescued from its ever-present confusion, darkness and dirt has gone the way of a good many other highly respected traditions.

Conveniences for the comfort of employes include individual steel lockers, sanitary wash basins and sanitary drinking fountains. A number of shower baths are also to be provided. The building is heated by steam pipes which extend to every department from basement to charging platform.

BRONZE MEDAL AWARDED ROBERT BUCHANAN

OBVERSE and reverse sides of the medal recently awarded to Robert Buchanan, of Birmingham, Eng., by the Royal Society of Arts for his paper on "The Application of Science to Foundry Work," are shown in the accompanying illustrations. The presentation was made for the reason that this paper was the best given during the year, in the estimation of the society. The paper was read in London in February last, and the presentation was made by Sir William White, the well-known naval architect, who was at that time president of the Institute, and has since become president of the Institute of Metals. The illustrations render further description of the medal unnecessary, except to add that the explanatory inscription appears on the edge of the medal as follows: "Robert Buchanan, for his paper on The Application of Science to Foundry Work, 154th Session, 1907-8."

The award constitutes an exceptional distinction, and is believed to be the first made to a foundryman. Mr. Buchanan has been the recipient of very hearty congratulations on his success. He is very well known in America as the first president of the British Foundrymen's Association, established about five years ago, and for some years president of the Birmingham branch, a position he still holds. He commenced his career as apprentice in the works of John Ure & Co., Dumbarton, and had his first experience of iron testing in conjunction with Denny & Co., engineers and shipbuilders of Dumbarton. For some years he was foundry manager to Messrs. W. & T. Avery, weighing machine makers, who have an establishment in America as well as in Birmingham, and at present he is director of the firm of Chamberlin Hill, Ltd., Walsall & Lichfield. He is in the very front rank of scientific foundrymen, and among other papers contributed to foundrymen's meetings at various times are the following: "The Mixing and Melting of Foundry Irons;" "The False Witness of the Test Bar," and others. A year ago he was president of the South Staffordshire Iron & Steel Institute, and still holds the office of vice president.

OBVERSE AND REVERSE SIDES OF THE MEDAL PRESENTED TO ROBERT BUCHANAN

COMPOSITION OF THE MODERN BRONZES*

A discussion of the deoxidizing elements used in copper alloys for increasing their tensile strength and ductility

BY C. VICKERS

UNDER this head we will classify all alloys of copper which contain some metal or metalloid, the use of which in alloys has been possible only within recent years. The modern bronzes, therefore, comprise those alloys containing aluminum, silicon, magnesium, phosphorus, manganese and iron. These elements, with the exception of aluminum, are not used to form alloys of copper in the same manner as tin, zinc or lead, but act as deoxidizers of these alloys, increasing their tensile strength and ductility.

Aluminum.

Taking these various elements in the order named above we will first consider aluminum. This metal when alloyed with copper forms the well known aluminum-bronze, the introduction of which was a radical departure from the old time bronzes, but it was found difficult to cast and as the demand for it never became sufficiently insistent to induce the founder to overcome these difficulties, the alloy fell into disuse, which was also the case with the copper-tin-aluminum alloys. At the present time, aluminum in copper alloys is confined almost exclusively to the copper-zinc series, forming aluminum brass. The content of aluminum in such brass is usually very small, compared with aluminum bronze, and is added to impart fluidity to the alloys more than for any deoxidizing or strength increasing qualities the aluminum may possess. A typical alloy is copper, 56 per cent; zinc, 44 per cent; aluminum, 6 ounces. This metal being cheap and running exceedingly fluid has found great favor for making such plumbing goods as ferrules.

Mixtures for Small Brass Castings.

It is this property which aluminum possesses of imparting fluidity and preventing the oxidation of the zinc, thereby suppressing the smoke, which is such a disagreeable feature in casting yellow alloys, which has caused this metal to be so extensively employed for small brass castings, such as saddlery hardware, etc. An alloy used for this purpose is copper, 60 per cent; zinc, 36 per cent; lead, 3 per cent, and aluminum, 1 per cent. Large castings are difficult to cast without dross, and various schemes such as horn gates, skim gates and long runners are used to overcome this difficulty. The most important feature however, is to pour the metal at as low a temperature as possible. Aluminum is used in almost all the modern bronzes, the exception being silicon and phosphor bronze.

Silicon.

The use of silicon in the brass foundry is largely confined to making copper castings. It is used in the form of silicon-copper, which is supposed to contain from 10 to 30 per cent of silicon. An analysis of one of the best makes showed only 9.63 per cent silicon, the balance copper. This was a brittle alloy and one-fourth of 1 per cent would make copper castings solid. It is advisable though, in ordinary practice, to use 1 per cent at least. The effect of silicon on brass is very similar to aluminum, in fact, it is difficult to tell whether silicon or aluminum has been used when the metal is in a melted state. Silicon is better than aluminum for many purposes in zinc alloys, as the castings do not run so drossy and are softer, but it cannot be used in the presence of lead, except when aluminum also is added. For all yellow brass castings free from lead, where strength and fluidity are desirable, silicon can be recommended. In an alloy of 60 per cent copper, 40 per cent zinc, the addition of 1 per cent of 10 per cent silicon-copper increased the tensile strength of a cast bar to 50,000 pounds per square inch, which will compare favorably with manganese bronze cast in the same manner, viz., into a round bar molded in the ordinary manner with a 3-inch cope, the metal being run straight into the casting.

Use of Silicon.

Experiments have shown the writer that silicon possesses no great value in copper, tin or zinc alloys, even when used in minute quantities. When silicon is used in bronzes, zinc should be omitted. A bronze containing 5 per cent tin and 1 per cent silicon is a good alloy for trolley wheels. When lead is present in any alloy, silicon cannot be used. The casting will be coated with a white deposit as if lime washed and will be full of dross. For this reason silicon cannot be recommended as a deoxidizer in brass founding, as a small quantity will create havoc in scrap metals, as these metals always contain lead, and the castings will be drossy for the third and fourth melt, and will have to be proportioned in new metal to be used up. Much more could be said in regard to this element, but in a short article space forbids.

Magnesium.

We will next consider magnesium. This is also used as a deoxidizer of copper in the proportion of two ounces magnesium to 100 pounds copper. The conductivity of such copper is high, but the castings are very liable to defects and cause considerable loss, as these defects do not show until the work is machined. One concern has partially overcome this difficulty by the use of a small quantity of phosphor-tin with the magnesium, about 6 ounces to 100 pounds of copper. Magnesium is an excellent deoxidizer for brass, but it must not be used too generously as two ounces to 100 pounds of copper are sufficient. This should not be exceeded in brass. In an alloy of 65 per cent copper, 35 per cent zinc, three ounces of magnesium were used. The metal did not run well, the castings being black and drossy. This was due to excess of magnesium.

Phosphorus.

This element is so well known to all brass founders that it needs no description. It is used either in the stick form as yellow phosphorus, or in alloy with either copper or tin. It is the best deoxidizer known in brass founding, being especially valuable in the copper-tin alloys, with which it forms the well-known phosphor bronze. The old style phosphor bronze was so rich in phosphorus that it would cut into the

*Presented at the February meeting of the Pittsburg Foundrymen's Association.

sand of the mold, much like water, and for that reason required special training of the molder or furnaceman to gage the proper casting temperature, otherwise the castings would be shapeless masses of mingled sand and metal. Of late the tendency has been to go to the other extreme, some writers contending that only just so much phosphorus should be used, as will remove the copper oxide from the metal. As this oxide is a variable quantity in every heat, it is difficult to put this theory into practice. It is stated, however, that 2 per cent phosphor-tin (containing 5 per cent phosphorus) is the maximum amount of phosphorus to use. In the writer's opinion this is not borne out by practice, as the strongest phosphor bronze contains more than twice that amount of phosphor-tin. An alloy of 90 per cent copper, 5 per cent block tin and 5 per cent phosphor-tin has been found to possess a tensile strength of from 38,000 to 42,000 pounds per square inch, with an elongation of 22 per cent. A wall of this alloy, 3 inches in thickness, withstood a water pressure of 5,000 pounds per square inch. In place of the phosphor-tin, yellow phosphorus was tried, the formula used being: Copper, 90 pounds; tin, 10 pounds; yellow phosphorus, 10 ounces. The tensile strength of this alloy was 36,000 pounds per square inch. When the phosphorus was dropped to 5 ounces the tensile strength fell to 22,400 pounds, which speaks for itself.

Manganese.

This also is a good deoxidizer for bronze, but it must be used in small quantities, not sufficient to discolor the castings. It strengthens the copper-tin alloys, if used with discrimination, but it will do more harm than good if not, as tin seems jealous of all the modern deoxidizers except phosphorus, and the writer has found that a combination of all these deoxidizers, in certain definite proportions of each, is necessary to obtain some results, because one will counteract the evil results of another, producing a perfect deoxidation of the metal, and at the same time also freeing it from the weakening effects of hydrogen, nitrogen and sulphur. Metal so purified is entirely different from the ordinary bronzes of the same composition, and combines the strength of the yellow alloys with the casting qualities and golden color of the tin bronzes.

Mixtures.

An alloy of 90 per cent copper, 5 per cent tin, 4 per cent zinc, 1 per cent deoxident, possesses the same quality of tone when cast into bells as the standard alloy copper, 80 per cent; tin, 20 per cent. The elimination of the gases in copper is the secret of the superior strength of the modern bronze, and the reason why two alloys of practically the same composition—as shown by analysis—differ so much in strength, elongation, etc., is that the maker of the better alloy had discovered how to remove the above inpurities from his metal, while the other had not.

While manganese acts as a deoxidizer in the well known bronze or brass of that name, it will not of itself remove all the impurities in the metal. Consequently, when manganese only is used, it is not possible to obtain the maximum strength in the alloy, and to this fact must be attributed the failure of many brass founders to make a high grade manganese bronze.

Manganese Bronze.

Manganese and copper unite readily to form alloys, provided the proper temperature is reached by the furnace. If 30 pounds of copper are alloyed with 10 pounds ferro-manganese the resulting alloy is white in color, and will give approximately the following analysis: Copper, 80 per cent; manganese, 16.3 per cent; iron, 1 per cent. In making manganese copper it is usual to alloy them in the proportion of copper, 65 per cent; manganese, 35 per cent. When zinc, lead and aluminum are added a silvery alloy is formed, variously known as "silver bronze," "manganese silver" or white bronze. This metal is superior in color to German silver, does not readily tarnish, and will resist most acids. When higher percentages of manganese are used, exceedingly hard alloys result. The writer has made them so hard that they will readily cut glass and the glass will break along the cut. Manganese discolors brass and bronze. One-half of 1 per cent manganese copper is sufficient to discolor brass, and the color is dark brown approaching black. It can be used to advantage in all yellow brass, but just sufficient should be used to color the castings a rich reddish brown. The improvement in solidity, strength and casting qualities is very noticeable.

Iron.

The last element on our list is iron. This metal is regarded more as an enemy than a friend by the brass founder. That is because it is generally found too abundantly in brass, and causes lots of trouble in removing it, and when not removed causes dirty, shrunken castings. The earliest of the modern bronzes, however, owed their superior qualities to the iron they contained. The well known Delta metal, sterro-metal, Tobin bronze, Aich metal, were alloys of copper, zinc and iron. The greatest difficulty in making alloys with iron, is to get the iron to combine with the copper, as these two metals are difficult to alloy. Many founders imagine there has got to be a carrier of the iron, and manganese has been credited with this property, but this metal is much inferior to silicon in this respect. The only way to add iron is in the form of a salt of iron. In this manner we can make solid copper castings, as the iron is a deoxidizer of the copper, and such castings possess high conductivity, being very valuable for electrical work. An alloy of 55 pounds of copper and 40 pounds of zinc, containing about 1 per cent iron, rivals manganese bronze in strength, and can be cast easily without the aid of aluminum, the castings being of a pleasing brown color. Iron has also been found to greatly improve the tone of bells; it is also used in spring bronzes, as it imparts elasticity to the alloy.

Conclusion.

In conclusion, the superior qualities of the modern bronzes depend upon the little things they contain. The small quantities of aluminum, silicon, magnesium, phosphorus, manganese, iron and occasionally sulphur; to these they owe the qualities which distinguish them from ordinary alloys. The content of copper, tin, zinc, lead, etc., are easily determined by analysis. The little things generally escape, or are considered of no consequence. The founder who seeks to imitate a superior alloy from analysis will be wise to pay more attention to the "impurities" than to the easily determined metals which form the body of the alloy, for the body is of no special value if the spirit is absent.

TITANIUM FOR PRODUCING SOUND COPPER CASTINGS.

A. J. Rossi, of the Titanium Alloy Mfg. Co., Buffalo, N. Y., has recently patented the use of a small quantity of titanium in the production of sound copper castings. It is introduced into the molten copper by means of an alloy of copper and titanium containing from 8 to 10 per cent of titanium. From 1 to 2 per cent of this alloy is used, and from 0.10 to 0.20 per cent of metallic titanium is therefore introduced. No trace of titanium can be found in the finished copper casting and its function, therefore, is to reduce the oxide and combine with the gases in the molten metal. The oxide of titanium is thus formed which floats to the top of the copper.

THE SAND BLAST IN THE FOUNDRY---III

A discussion of various mechanical devices used for handling sand and cleaning castings --- Sand-blasting and pickling compared

BY JAMES M. BETTON

IN SOME cases, mechanical devices for handling sand may be used, but their adoption should be made with a fair knowledge of the facts that they cannot fail to wear quickly and constantly, owing to the nature of the material they carry, and that the items of renewal and repairs are also considerable and constant.

These devices may be divided into:

1—Those depending upon a partial vacuum or suction to carry the sand from its place of deposit, usually in a pit beneath the sand blast room to overhead tanks, during the passage to which any floating dust that may be present is removed by deflecting screens and the sand is graded and sifted ready for use again.

2—Another and more common class of device, the ordinary bucket elevator, the boot being arranged in some cases so that the sand flows into it, otherwise it is filled by hand, the delivery being made into suitable hoppers overhead, the sand passing through screens to remove large objects that would cause trouble in the nozzle later. The bucket conveyor can be designed for almost any location, and it is a convenient method of elevating, if elevation is needed.

Cost of Operating Conveyor.

Considering the expense for power to operate the conveyor, or the exhaust elevator, the constant wear and charge for renewals and repairs, the time the operator is occupied in attending to these mechanical devices, and the fact that they are usually out of sight, it will be found that it is less expensive to handle the sand from the cleaning room floor, through a riddle or series of sieves, and back into the sand blast, by hand labor. A laborer and a shovel do not come high, there are no repairs, the results are just as good as far as the cleaning of the castings are concerned, and the daily expense will be less than when machinery is used. One man will operate the sand blast, and by arranging his work on the sand in the intervals of removing cleaned castings and receiving new ones, no time will be lost, and the cost of cleaning will be reduced.

Mechanical Cleaning of Castings.

The sand blast was designed to clean one casting at a time and in most instances this is carried out, but there are many small castings, to handle each of which individually would require too much time, sand and power, and these are best cleaned mechanically.

In many foundries there is a constant number of castings from the same pattern which can be cleaned to better advantage mechanically, the work being brought to the sand blast and each piece treated in the same routine.

In Europe, mechanical devices for the quick and careful cleaning of castings have been in use for a number of years, Germany and France leading in devices for turning out this work. Horizontal round tables, revolving on a shaft within a sheet iron housing provided with a dust exhaust, are used to a considerable extent. The casting is placed by hand on the table, which projects beyond the front of the housing, and as it revolves they pass under one or more sand blast jets until cleaned, the operator turning them as needed and removing them when cleaned, the work going on at a regular degree of speed and thoroughness.

Cleaning Flat Work.

In another form, for cleaning flat work, sheets of metal, etc., the material is carried on an endless table or other conveyor through a cleaning box with dust exhaust attachment, under a series of sand blast jets depending from above, sometimes stationary and in other instances movable.

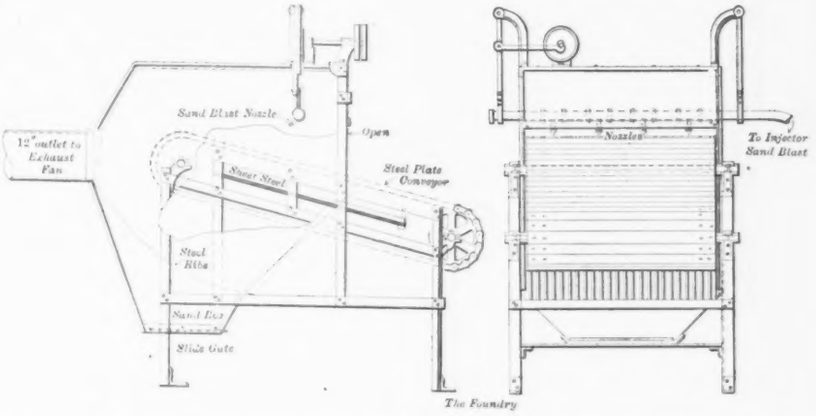


FIG. 1—END AND FRONT ELEVATION OF AUTOMATIC SAND BLAST CLEANING DEVICE

In the United States these machines have not been used to any extent, but there are many cases in which they can be used to advantage, and their use will extend when their practicability is demonstrated by progressive makers of sand blast apparatus and their frequent adoption becomes but a matter of time.

Individual Application.

Each proposed application must be the subject of a careful study and consideration of the work to be done by the machine, and while the gen-

eral outlines, sizes of tables, housings, arrangement and adjustment of nozzles and other details of construction will be more or less identical and arbitrary, the question of speed must be considered well in every instance and regulated to obtain the desired output in a given time, without slighting the cleaning. A fair amount of time must be allowed for the process; passing castings under a stream of sand and air is not going to clean them if not enough time is allowed for the sand to act on and to reach every part in line, exposing the original metal. With a proper allowance of time, suitable gradation and location of the sand jets, adequate air pressure and well graded dry sand, excellent results will be obtained, and if these details are not carefully considered, both the maker of the machine and the user will be disappointed.

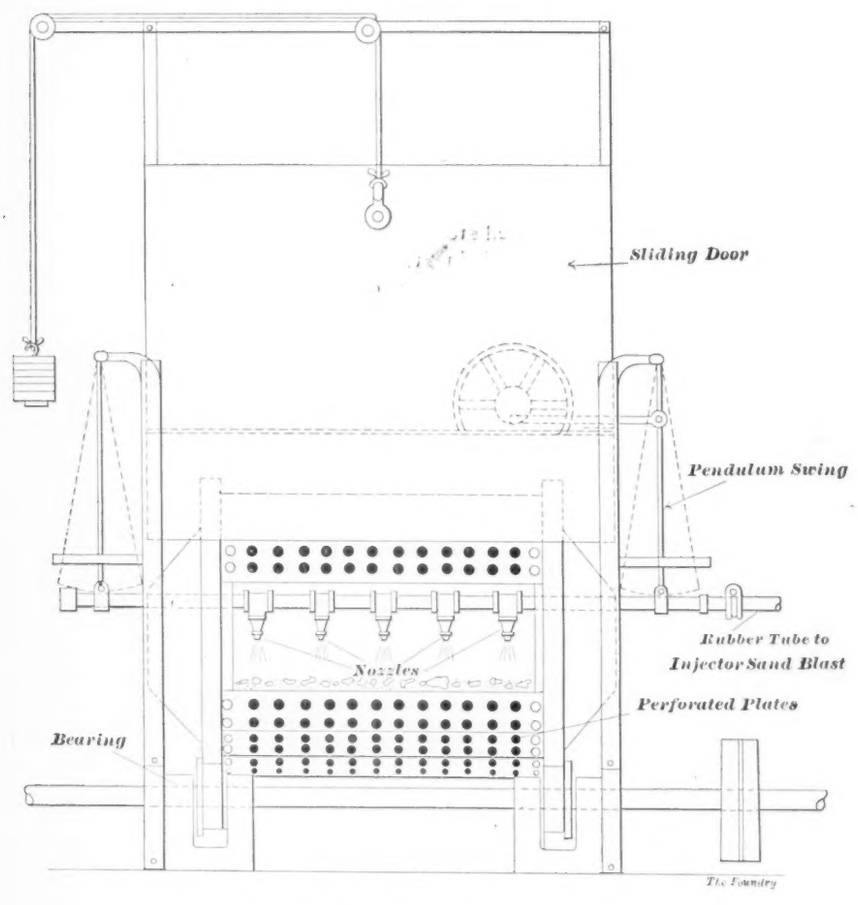


FIG. 2—SAND BLAST TUMBLING MILL

Advantages and Disadvantages.

The advantage of these machines lies in the quantity of castings that can be cleaned by one man satisfactorily and without discomfort from dust, and the saving of the good sand is another important factor. Among the disadvantages are included the action and presence of the sand which is liable to cause active wear, requiring overhauling and replacing of parts, and care should be exercised that the sand jets touch only one side of the exposed casting; but if the device is made of standard material, the cost of renewals and repairs need not be great, and if it is remembered that in cleaning any casting by hand, it has to be turned over exactly the same as will occur on the table, the comparison will not be unfavorable.

In Fig. 1 is shown a mechanical sand blast cleaning device of American manufacture in which the castings are placed on the projecting end of a conveyor table which travels at a moderate speed, bringing them under the sweep of a number of sand blast nozzles, which are swung over the work at right angles to the line of travel of the conveyor. A reciprocating motion is imparted to these nozzles by a simple crank and connecting rod attached to the top of the housing, the nozzles being suspended from simple brackets, the number of revolutions of the nozzle crank being made proportionate to the speed of the conveyor. The castings pass through the cleaning zone and fall over the end of the conveyor on a perforated steel plate set at such an angle that they will slide freely either into a box or upon a table for inspection and sorting, the sand falling through the perforations in the plate into a hopper below, from which it is returned to the sand blast tank after screening. The dust is removed by an exhaust fan and delivered to a proper collector. The rear of the box is made long to allow the heavy sand to separate from the dust and settle.

Adapted for Small Work.

This form of machine is especially adapted for cleaning small, thin, malleable and other castings, which it is not advisable to clean in the tumbling barrel, because of danger of breakage and damage to sharp edges, points, etc., and in its operation there will be found a certain working of the small work and a reflection of the sand causing a very good cleaning on both tops and bottoms, and any pieces may be passed through the machine a second time without material loss of time. These machines are capable of being made in many forms to suit individual cases, the general principle and outline being preserved.

Sand Blast Tumbling Barrels.

Castings, especially of small size, have been cleaned in tumbling barrels into the interior of which jets of air and sand are projected from a sand blast through hollow trunnions, during the process of revolution.

The barrel is perforated to allow the sand to fall out and is usually enclosed in a sheet metal housing to which is connected an exhaust fan to remove the dust which is excessive in these machines, especially when they are operated at high speeds, the castings grinding the sand into dust.

The action of the sand blast in barrels so arranged is not always satisfactory. If the nozzles are introduced through the trunnions in a horizontal line, it is evident that but a very limited area at the ends of the barrels will be reached by the blast, and that a somewhat greater area is gone over if the nozzles are carried in at an angle, which must be limited, decreasing with the length of the trunnions. Much of the cleaning in barrels so designed is due more to

the revolutions of the barrel than to the action of the sand blast.

A Novel Tumbling Barrel.

In Fig. 2 is shown a sand blast tumbling barrel in which the principle employed in the cleaning device, previously described, is utilized. This barrel is constructed of sheet steel, perforated to discharge the sand. It revolves on roller wheels, the power being taken from a line of shafting overhead; a sheet-steel housing with a balanced sliding door confines the dust, which is removed by an exhaust fan or blower. The central portions of the heads are built flaring out, and are cut away to permit the admission of a line of sand blast nozzles, which, by means of power taken from the line shaft vibrate backwards and forwards parallel to the axis of the barrel.

The barrel being filled about one-third full is turned over from one to eight times per minute or only enough to turn over the castings and present all faces to the sand jets, the cleaning being done entirely by the sand blast, and not by tumbling, with the least possible damage to sharp edges, points and ornamentation.

An air pressure of 20 pounds will be found to give good results when used with a moderately fine, sharp, dry sand, much of which can be used again.

Sand Blast Cleaning Boxes.

In many instances it is desirable to clean castings of moderate weight, that can be easily handled, and to blow out core sand from valve and cock bodies without sand-blasting the exteriors. This can be done rapidly and without dust. For this purpose, cleaning boxes, in general design as shown in Fig. 3, may be used.

They can be made of wood, metal lined, or of sheet metal which, while costing a little more, will warrant the additional cost by reason of the greater durability.

The fronts of these boxes are entirely open, a fine wire screen, attached at an angle at the top, allows the workman to see the work in hand without danger to his eyes from flying particles of sand. The top slopes back to a connection with an exhaust fan, which will maintain a current of air inward and carry with it all dust. The interior may be lighted by an electric light to advantage, the better the light the better the quality of work.

An iron wire screen, extending over the top of the hopper, furnishes a place on which to rest the work and allows the sand to fall through, to be drawn off by a simple gate for use again.

Cleaning boxes of this description can be used satisfactorily in the open foundry or cleaning room, a suitable draft being kept passing through them, and in many cases they take the place of a special cleaning room. They can be recommended for economy of space, comfort in operation, and saving in expense of construction.

Sand Blasting and Pickling.

The common method of pickling is to arrange the castings from which the adhering scale and sand is to be removed upon wood racks, over an inclined boarding, and to pour over them by hand the acid, keeping them thoroughly wet until the scale is loosened, or to immerse the castings in a bath of pickle, letting them soak until the same result is obtained. As strong and noxious fumes rise from the pickle, the room must be well ventilated, and even then it is neither a pleasant nor healthful occupation.

The acid will spatter and burn the skin, clothing or shoes of the workman, and the burns upon the person are often painful and slow to heal.

That pickling will do the work is not denied, but it implies the presence of dangerous fumes, danger to the workman, extra handling of the work, which has to be put into pickle, removed if in a bath, allowed to drain, washed off with a hose and removed for delivery to the machine shop. All of these operations require more time than the cleaning of the casting by the sand blast, without taking into consideration the time during which they must be immersed or kept wet with the acid, which will vary from several hours to a day or sometimes even more. The sand blast cuts off the burnt sand, and any scale, which is practically the same thing, within a few minutes, down to the original metal, so that there is no dulling of the cutting points and edges of tools and complaints from the work of hardness, and arrives at the same result in far less time, with the advantage of less labor. While there may arise some dust from the operation, this is not as objectionable or injurious to either the workman and his surround

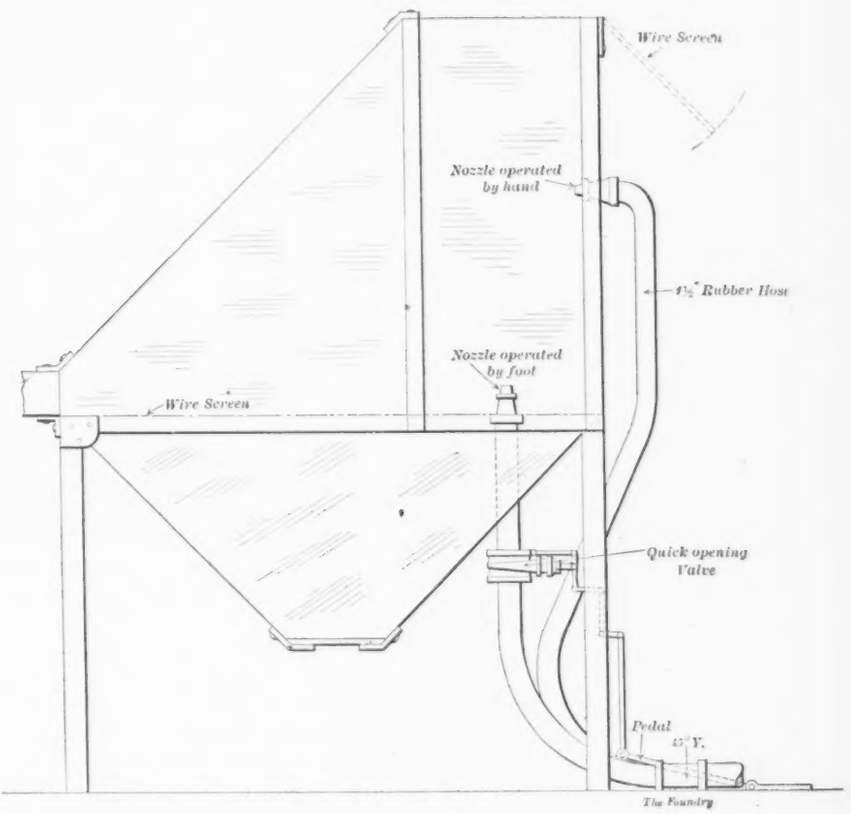


FIG. 3—CLEANING BOX FOR SAND-BLASTING CASTINGS OF MEDIUM WEIGHT

ings as the fumes from the pickling bath.

An exhaust fan properly located and operated will do much to ameliorate the conditions in either case.

EXCESSIVE SHRINKAGE OF BRASS VALVES.

Question:—I have been having a great deal of difficulty with brass valves which show unusual shrinkage. My mixture started with gun metal, 1 to 9, and was changed as follows: 1 to 8, 1 to 12 and 1 to 23, with invariably the same result. These mixtures were poured at varying temperatures, but the shrinkage remained the same. We also used about 0.05 per cent of zinc. Would the shrinkage be reduced by the use of about 4 ounces of bismuth of 100 pounds of copper? These castings have been cast both on the side and on end. Which method would you suggest as the most satisfactory? I have also tried inserting a steel rod through the stem from end to end, but the shrinkage continued unchanged.

Answer:—A simple method of overcoming your difficulties would be to run these castings with a horn gate of generous dimensions attached at the bottom of the stem. This will force the metal through the thickest portion of the castings and feed the heavy section where the difficulties occur. No details of gating are given but it is presumed that the gate was placed at the edge of the disc as that would be a natural thing for the molder to do. In using a horn gate a large sprue is essential, and in this case it should be at least 2 inches in diameter. It will then act as a feeder and will supply metal to the casting as it sets. Probably this is where you have erred, and if so, try a larger sprue. If not successful use the horn gate if you find it best to cast horizontally. Furthermore, would suggest that the gate be placed on the longer end of the stem using a 2-inch sprue and inclining the mold so that the sprue end is raised about two inches. The head of the sprue should be three inches higher than the edge of the disc, which in this case is vertical. It would also be advisable to vent the cope by threading a thin vent wire through it. If you try this method and fail, change your mixture to the following: Copper, 90 pounds; tin, 8 pounds; phosphor tin, 2 pounds. The small amount of zinc used in the mixture had no beneficial results. I advise the use of 3 per cent zinc in any of the mixtures mentioned. K. K.

THE MANUFACTURE OF STEEL CASTINGS IN SMALL QUANTITIES*

With a converter of one thousand pounds capacity, by the new Tropenas system

BY ARTHUR SIMONSON

THE fact that we are now able to procure, in many steel foundries, castings of good quality has resulted during the course of the past 20 years in a great transformation in construction in general, and in mechanical and metallurgical construction in particular. Heavy and massive pieces are made in the open-hearth furnace, and medium and small pieces in the converter. The open-hearth has played its important part in the development of the now extensive steel foundry business, but it is principally the small converter which has been the principal factor, on account of its more easy adaptation to all the details of miscellaneous manufacturing, its elasticity of production and its cost.

The Converter.

The converters generally used in the steel foundries have a charge capacity varying from one to three tons. The two-ton converter which is convenient for the manufacture of pieces of all weights, from one pound to ten tons, has been the one most generally employed, by the smaller foundries as well as by those of larger production. The 1-ton type, of which the cost of installation is little less than that of one of two tons capacity, has been little employed.

Since the marvelous invention of Bessemer, numerous metallurgists have tried to adapt the principle of his pneumatic process to a type of converter of very small capacity, capable of producing steel castings which may be substituted on the one hand for ordinary cast iron, which is too fragile, and on the other hand for forgings, which are too costly.

History of the Pneumatic Process.

It was Daniel Adamson, who, by his first researches in 1864 on lateral blowing with multiple tuyeres, opened the way which was followed by numerous experimenters until 1884, the period of fixed converters, which was characterized by the work of James P. Witherow, William J. Clapp and Thomas Griffiths, whose processes were used with more or less success for a considerable period. Then followed Charles Walrand, who applied the blast to one side of a movable converter, served by tuyeres of large section.

Robert, by adopting the Walrand principles, arrived at an approximate solution of the problem of the manufacture of mild steel castings direct from the converter, about 1880. The Robert converter met with an encouraging success. It permitted the manufacture of good steel, and was used in a number of foundries. The apparatus is movable; it is fitted with a small number of tuyeres of large section, arranged on one of the sides, which is straight; the compressed air acts through the metallic bath and near its surface, maintaining a gyratory movement which stirs the metal during the blow.

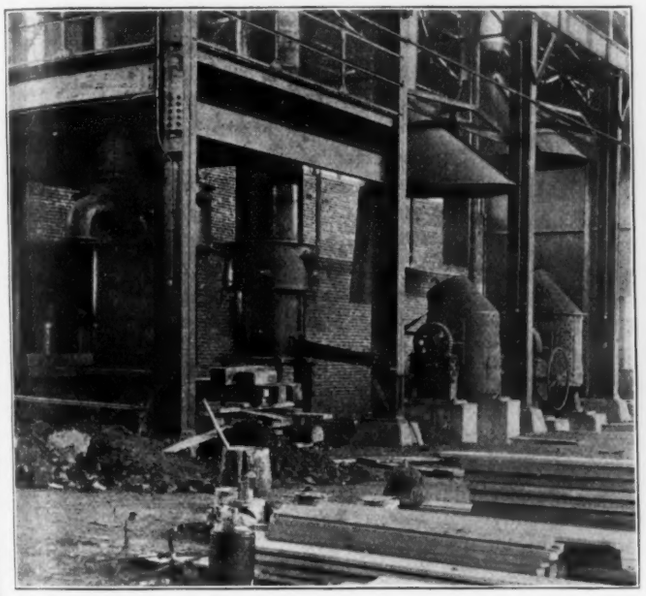
In 1890, A. Tropenas established the new principle of blowing above the surface of a deep bath, to avoid the violent stirring considered by his predecessors as the indispensible condition of successful pneumatic operation.

Tropenas Converter.

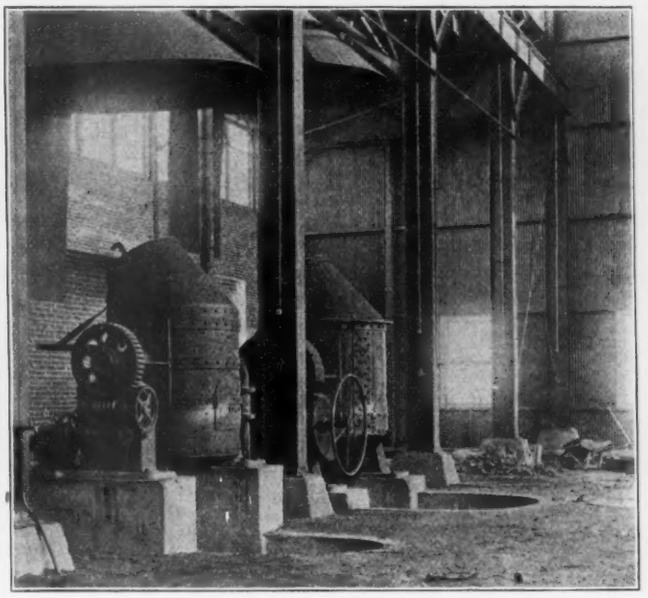
This new Tropenas converter was much discussed from the moment

*Presented at the January meeting of the Philadelphia Foundrymen's Association.

of its appearance, by metallurgical writers who did not attempt to disguise their disdain for a process in which one of the principles taught by them was so outrageously violated. The steel obtained by this process which avoided the irregularities of the other methods, gave results of such a nature that the specified requirements of war and navy departments, railroad companies and consequently the general industries were fully met. It was then installed by numerous establishments in the United States and foreign countries. The English, Russian and Japanese governments adopted it in their arsenals for the manufacture of special sections. The United States government installed it in five navy yards. It was, with few exceptions, the 2-ton converter which was adopted in these numerous steel works.



FOUNDRY OF THE TROPENAS STEEL CO. AT NEWCASTLE, DEL., SHOWING CUPOLAS AND HALF-TON AND TWO-TON CONVERTERS



TROPENAS STEEL CO., NEWCASTLE, DEL., HALF-TON AND TWO-TON CONVERTERS

Small Converter.

The cost of a 2-ton Tropenas installation, while much less than that of a Bessemer plant of the same capacity, represents an important investment which cannot be made except by establishments possessing sufficient capital.

Many small foundries, for which the addition of a small steel department would be a most valuable complement, recoil from the expense. So the question has often been asked if it were not possible to bring out a type of converter which, instead of two tons, would be able to treat charges of 1,000 pounds only, employing high pressure blowers instead of the too costly blowing engines, with the power apparatus and accessories reduced and proportioned to the smaller charge. The importance of the solution of this problem to the small metallurgical industry was appreciated, but the different attempts that had been made with converters of very small capacity had not given sufficiently conclusive results to recommend them.

However, since 1890, several engineers have constructed different types of converters with greatly reduced charges, but the results have given very little encouragement. It is very difficult to effect pneumatic refining conveniently when operating on a small mass of metal.

Refining Small Charges.

For a pneumatic refining of a small charge it is necessary for the heat developed by the oxidation of the elements of the iron to raise the temperature of the bath rapidly to a high point, and that the temperature continually increase until the end of the operation.

In the treatment of a small charge, the loss of heat, by comparison to the mass, is very high, and the least error or the smallest negligence on the part of the operator leads to an irregular and tumultuous blow, which produces a steel of bad quality, or too cold to be handled for the ordinary purposes of a steel foundry.

For a small converter to respond to the requirements of the small metallurgical industry it is necessary:

1—That the steel obtained at the end of the blow be at a high temperature; that it be very fluid and that it retain that fluidity long enough to be distributed in small ladles and cast without haste or precipitation into the molds which have been prepared.

2—That the mild steel obtained be of an entirely regular quality, and entirely deoxidized, to produce sound pieces, when the molds have been properly prepared.

3—That the mechanical results obtained meet the conditions demanded by the governments and railroad companies.

4—That the refining method be so simple that it can be comprehended in a few weeks by any intelligent workman.

5—That the expense of the installation be not too high.

The numerous experiments made under the direction of Mr. Tropenas have permitted the realization of this type of small converter, which solves in an absolute and complete manner the problem of the manufacture of steel castings in small quantities by the pneumatic process.

The small converter is not intended to supersede the 2-ton vessel which is now used, when the amount of castings averages 100 tons per month or more, but it may be a valuable complement for a cast iron or brass

foundry, or for a construction firm which desires to be independent of the large steel foundries.

Necessary Equipment.

The necessary equipment for this process is as follows:

A cupola of special design, to melt the iron which is to be refined in the converter, and a special low pressure blower to serve this cupola; a special converter in which is charged the iron previously melted in the cupola; a special high pressure blower designed to produce the compressed air for refining the iron in the converter; a small crucible furnace in which is melted the final addition used to reduce the oxidation of the metallic bath; the necessary motors for driving the cupola and converter blowers and the accessory apparatus; cranes for handling the casting ladles and molds; the materials and tools generally employed in all foundries, including flasks, drying stoves, annealing furnaces, molding material, etc.

If a steel department is to be added to an iron foundry it should be separated entirely from the latter to avoid the mixture of the pig iron and scrap.

Analysis of the Iron Used.

The iron used is of the low phosphorous grade and the analysis limitations follow:

	Per cent.
Carbon	3.80 to 4.50
Manganese	0.50 to 2.00
Silicon	1.80 to 3.00
Sulphur	Maximum 0.05
Phosphorus	Maximum 0.06

Carbon.—The carbon is not an element of prime importance and may vary between limits greater than those indicated above.

Manganese.—The manganese may also vary between limits a little more than those of the table above, but it may result in the rapid wearing of the lining.

Silicon.—The proportion of pig iron entering into the charge for the cupola should be regulated by the quantity of scrap, gates and heads which it is desired to utilize. As a general rule it is good practice to use all or the greater part of the scrap, gates and heads which are produced in the steel foundry. The greater the proportion of scrap used, the greater must be the percentage of silicon in the pig iron used.

Operation of the Converter.

The mixture of pig iron and scrap is melted in the cupola, then tapped into a ladle which is lifted to the level of the mouth of the converter placed in the charging position, and its contents are poured into the vessel. The converter is then placed in the blowing position and the blast is admitted through the tuyeres. This operation is pursued up to the point of the complete transformation of the pig iron into steel. It lasts about 15 to 20 minutes according to the nature of the iron treated. The conduct of the operations is exceedingly simple and any intelligent workman can become a good operator in a short time.

Adding the time of blowing to the time of casting, the complete operation requires about 35 to 40 minutes. Counting five minutes for charging the converter, it is possible to make a complete operation, or to produce about 1,000 pounds of steel every 45 minutes; that is to say, in a working day of 10 hours, one can make and cast 12 heats of 1,000 pounds each, and produce approximately six tons of steel.

Cost of Production.

Taking as a basis the output given above, and supposing that a small steel foundry casts twice a week, we shall obtain the cost of the steel in the ladles as detailed below, which is verified by experience. The loss due to the melting in the cupola and the refining in the converter is from 15 to 18 per cent. In making the above calculation we have used 18 per cent so as to be on the safe side; but the total loss, which varies according to the analysis of the pig iron is, on the average, smaller. This, therefore, makes necessary in our calculations a total of 15,600 pounds of the mixture of pig iron and scrap for a net production of six tons of liquid steel, taken as the basis of the cost of production, the mixture melted in the cupola being composed of two-thirds pig iron and one-third scrap.

COST OF PRODUCTION.

10,400 pounds pig iron at $21 per ton	$100.10
5,200 pounds steel scrap at $15 per ton.	41.25
2,030 pounds coke for cupola at $4 per ton	4.10
620 pounds limestone at $2.50 per ton	0.80
One man and helper for cupola	4.00
7½ horsepower for cupola blower at five cents per kilowatt hour	2.80
1,100 pounds coke for converter and crucible	1.80
30 horsepower, three hours, for blower, five cents per kilowatt hour	3.40
One man and helper on converter	4.50
793 pounds ferro-silicon at $28 per ton	11.10
112 pounds ferro-manganese at $45 per ton	2.52
Aluminum	0.70
Linings for cupola and converter	5.00
Crucibles	2.50
Power for elevator and tilting converter	1.10
General expenses of manufacturing	25.00
Total	$210.67

Thus the price of the liquid steel ready to be cast into the molds is in the neighborhood of 1.60 cents per pound. This price does not include the general fixed charges of the enterprise, nor the interest on the capital invested.

Quality of the Steel.

The steel coming out of the converter being very hot and fluid, it is possible to cast pieces of very small size and extremely light weight. If the molds are well prepared and the sand of proper quality, the castings produced are clean and have a good exterior appearance.

The greater portion of the castings are made of soft steel which is almost exclusively specified by engineers. The test pieces tested by different customers at the foundry where two of these small converters are in operation, have given the following results on the usual soft grade of machine castings:

QUALITY OF STEEL.

Test pieces.	Tensile strength per square inch, pounds.	Elongation, inches.	Reduction of area, per cent.	Remarks.
A 17	61,520	19.40	43.70	Fibrous
A 19	62,830	17.09	39.20	Granular part fibrous
A 20	65,455	18.49	47.20	Fibrous
A 21	64,436	16.95	33.60	Fibrous
A 23	62,713	17.48	38.50	Granular part fibrous
A 25	65,294	20.14	44.20	Fibrous
B 110	71,359	21.08	43.60	Fibrous granular
B 112	75,572	20.41	39.14	Fibrous granular
B 115	74,617	22.17	40.26	Fibrous granular
B 117	72,972	23.45	35.61	Fibrous granular
B 120	77,733	19.90	34.80	Fibrous granular
B 121	77,049	19.85	36.56	Fibrous granular

This cast steel forges like mild rolled steel without taking more than ordinary precautions. It welds as well in a forge fire by taking the same precautions ordinarily used. This feature permits the casting of complicated pieces in parts which are afterwards welded together.

Compared to an open-hearth furnace of small capacity this converter has the advantage of being much more elastic, and it accommodates itself to intermittent use. When the converter is stopped all consumption of power and fuel ceases, but in the

case of the open-hearth one is obliged to keep up the fire after melting. The steel produced is hotter and more fluid than that produced in the open-hearth, and consequently produces less skulls. The steel made in this converter is of the same quality as the steel obtained from converters of greater capacity. The mechanical results do not show any difference. The blows are easy to manage, the periods are sharply and clearly defined, and the signs which indicate the finish of the reaction are clearly marked.

Discussion.

The discussion of Mr. Simonson's paper developed many interesting points regarding this process. In reply to a question as to the height of the converter, Mr. Simonson stated that the shell itself was about 6 or 7 feet above the ground. The fact that the baby converter did not have a conical bottom he said was a mere detail of construction and was only a question of balancing the vessel. The door on the side of the converter, he added, is a manhole used for passing bricks inside of the vessel when it is being relined, and in case of emergency if the lining should give way near the tuyeres.

Asked whether any of these converters are now in use, Mr. Tropenas said that three are in operation and another will soon be completed at the plant at New Castle, Del. Without repairing the lining he stated that 30 or 40 heats could be made, while 100 heats could be made with one lining provided repairs are made from time to time. The lining is made of a special sand composition, but if the converter is lined with silica brick the lining will last for a considerable longer period, but the cost of the same is somewhat increased. The blast pressure used in this converter, he stated, was about three pounds, and asked about the depth of the metal he stated that while not exactly the same as that in the two-ton converters, it is proportionately the same depth considering the surface and diameter, and the size of the converter inside. While the size of the blower used for the baby converter is not the same as that used on larger vessels, nevertheless, the pressure is the same in both cases, and may vary from three to five pounds per square inch.

Silicon.

Regarding the percentage of silicon, Mr. Tropenas said that less silicon is used in the small converter. Iron which is regularly used in the open-hearth furnace containing from 1.60 to 2 per cent silicon can be used in these small converters and the total silicon is, therefore, considerably below 2 per cent at the beginning of the blow. In this respect this process is not like the methods of side blow operations generally pursued.

Cost.

In reply to a question regarding the probable cost of a baby furnace including all of the equipment except the power, Mr. Tropenas ventured the opinion that about $6,000 would purchase all of the operating apparatus necessary for such a plant.

Continuing, he spoke as follows: "This problem of making steel castings in small quantities by the quick pneumatic process has been tried by several engineers, but no progress was made until recently because the methods advocated were not reliable. My experience during the last two years enables me to state that I have found a practical solution of the problem. We can now produce a perfectly regular quantity of steel in a very hot and fluid state which can be easily cast from small ladles without haste and which insures good sound castings."

Mr. McCarter—You have explained very clearly the cost of steel in large quantities, but there are many of us who are operating foundries to whom it might be a valuable adjunct to have one of these converters if a heat could be made on Saturday of about 2,000 pounds. Can this be done economically?

Mr. Tropenas—The cost submitted to you was figured on basis of the converter operating twice a week with 10 to 12 blows each time.

Mr. McCarter—The point that I was trying to bring out was this. If you would run these two or three blows at the end of the week would that materially reduce the life of the lining?

Mr. Tropenas—No, it makes no difference.

Mr. McCarter—We operate a machine shop and use about 2,000 pounds of steel castings every week. It is almost impossible to get them. They hold up the work. The work depends on promises which are never fulfilled.

Mr. Tropenas—In that case a 1,000 pound converter would give you your castings the same day.

Mr. McCarter—We bought in the last five months at least 200 tons of steel castings. We have on our floor a lot of work for a blast furnace that requires possibly 100 castings, which average 15 to 50 pounds. We have had to send back at least half of the order because of defects, and some of these castings have not been received yet from the steel foundries. Of course they have not all been placed with those having converters. A great many are with open-hearth foundries.

Mr. Tropenas—The question of defects is a different proposition. We can make good steel but to obtain good castings with good steel it requires good molds.

Demonstrating Plant.

Mr. Hibbs—I think nothing has been said here about the style of your plant. Is it a demonstrating plant, or a plant to go into the business commercially?

Mr. Tropenas—It is difficult to say where the demonstrating plant starts and where the commercial begins. If we want to show the operation of our new baby converter we shall have to make castings and we intend to sell them. You can therefore at present take it to be a demonstrating plant.

Mr. Jameson—Might I ask, how you account for the fact that for the smaller vessel you require lower silicon in the bath?

Mr. Tropenas—We require lower silicon because we want the first period of the blow to be as short as possible. We are treating a small mass of metal, so we want to rush the blow as much as we can and lose as little heat as possible.

Mr. Jameson—In that case you depend for your initial temperature on hot iron?

Mr. Tropenas—We also add, at a given period of the operation, manganese or silicon, in the proper form to obtain an increase of temperature in the bath, provided the element added will give a solid oxide, not an oxide gas.

Addition of Alloys.

Prof. Stoughton—Might I ask if the patents on adding that material at a certain period of the blow have run out—if that is a proper question to ask—or whether you have to pay any royalty to anybody for their use?

Mr. Tropenas—We do not pay any royalty. In previous processes, the addition of silicon has been made to raise the temperature of the bath. In that case, that addition was made after the end of the blow, and an after blow was necessary to finish the operation. The result was that the quality of the steel was very erratic. As the manufacture of steel castings requires a

great regularity in the steel, these processes have been abandoned.

Mr. Knight, Chester Steel Castings Co.—I would like to ask Mr. Tropenas what percentage of loss he has in this 1,000-pound converter? In other words, if he starts with 1,000 pounds of metal in his bath, what is the loss?

Mr. Tropenas—I take the loss in the cupola to be between 5 and 7 per cent. We have to get the metal very hot, and the total loss varies between 15 and 18 per cent. So the loss in the converter should be 11 to 13 per cent.

Mr. Evans—Suppose an iron foundry already established would like to put in one of these converters, could it melt the iron in its regular cupola?

Mr. Tropenas—Yes. An ordinary cupola would be provided; the inside could be made according to special instructions. When you have to treat the metal to obtain the steel in a small converter like this one, you want to minimize the oxidation of the elements of the iron while it is melted in the cupola.

Mr. Evans—About how much space would it require for an iron foundry to put in this baby converter?

Mr. Tropenas—The converter and cupola alongside of each other would take about 15 to 18 feet by 6 feet.

Mr. Evans—At what temperature do you pour the steel?

Mr. Tropenas—As far as I can say about 2,950 to 3,000 degrees Fahr.

Converters With Removable Bottom.

Prof. Stoughton—I would like to say first that Mr. Tropenas has solved some of the most puzzling difficulties in steel casting manufacture, particularly relating to small castings. I for one am very happy that he has solved this one, and to know how successful it is. I thought I would speak about the fixed bottom converter. I want to ask why they don't use a converter in two pieces, particularly such a small converter. You would think it would be more difficult to line a converter all in one piece unless you open the side. I would like to ask what is the form of the inside of this converter? And another thing, the blast pressure being the same and the height of the converter being less, you would think that the spitting would be excessive. The spitting is believed to be a great cause of loss in these converters. You would think that the spitting would be quite excessive in this converter and it would be interesting to know whether this is so.

Mr. Tropenas—In the first place you wish to know if the inside of the converter is the same shape as the two-ton converter. It is conical but the sides are not so steep as the other one. In regard to the spitting, if the length of the converter is one of the factors which interferes with the spitting during the blow there is another factor which is much more important to consider and that is the reaction of the carbon on the oxidized metallic bath, at a certain period of the operation, which takes place during the boil. We find in practice that these small converters do not spit more than the large ones, and when I built my first baby converter I make it much longer than the one we are now using. We found it was unnecessary to make it so long. The oxidation is not beyond ordinary limits, and the spitting is limited. In fact I have seen the converter blowing all day, 10 or 12 operations, practically without any spitting, even during the period of blowing.

Prof. Stoughton—About taking the bottom off. That is an American invention and especially interesting. That is to say, if it be of benefit to some converters, you would think it would be a benefit in this converter to have the bottom removable?

Mr. Tropenas—I do not see why the bottom of the converter should be removable. But I have had no experience with removable bottom converters. I would say this, that it is the practice in Europe to make the small converter in one piece, and we do not find very much trouble in making the lining, because instead of lining with brick we generally ram up a kind of a composition.

MERGER OF BLOWER MANUFACTURERS.

The American Blower Co., Detroit, and the Sirocco Engineering Co., of New York city, operating plants at Detroit and Troy, N. Y., respectively, have consolidated, and the business will hereafter be transacted under the firm name of the American Blower Co., with main offices at Detroit. James Inglis, executive head of the American Blower Co., has been elected president of the combined concerns; Wm. C. Redfield, formerly president of the Sirocco Engineering Co., has been elected vice president; Chas. H. Gifford, until about a year ago general manager of the B. F. Sturtevant Co., Hyde Park, Mass., treasurer; and F. R. Still, chief engineer of the American Blower Co., secretary. Sirocco fans were invented in about 1897 by S. C. Davison, were patented in England in 1898, in the United States in 1900, and in 1903 were introduced in this country by the Sirocco Engineering Co., of New York.

The principal feature of this fan is its blast wheel or runner. This is of drum form, with a large inlet chamber enclosed by numerous blades which are very long, but narrow, and are curved forward. Instead of having 16 blades, it usually has 64, and these are generally six to nine times as long as they are wide. The blades, instead of being flat or curved back, are curved forward. In the ordinary application of the word, "Sirocco" is the name of the hot and frequently scorching winds which blow over the sun-baked deserts of northern Africa and India.

In anticipation of a general improvement of business, and also to provide for increased foundry facilities and the consummation of the American Blower Co. and Sirocco Engineering Co. consolidation, the former concern purchased outright last year the plant formerly operated by the Northwestern Foundry & Supply Co., Detroit. The American Blower Co. also recently purchased a large tract of land across the street from its present property, upon which new buildings will shortly be erected covering approximately 175 x 300 feet. The plants at Detroit and Troy, N. Y., will continue in full operation under one management.

TRADE NOTES.

The Gobeille & Harris Pattern Co. has been organized at Niagara Falls, N. Y., by Joseph Leon Gobeille and William D. Harris. A building has been obtained and the new concern will begin operations at once, giving special attention to designing and manufacturing patterns for stove foundries. A capable art department has been organized to make patterns for artistic metal work. A study of molding machine practice will be made on account of the general interest being taken in the use of the molding machine in stove foundries. Mr. Gobeille has been long and favorably known as one of the leading patternmakers of the country, and with a good shop, new tools and low costs, the new concern starts under favorable auspices.

The H. E. Mills Manufacturing Co., Syracuse, N. Y., is to erect a large brick factory building in that city for the production of its core compounds. Plans have been prepared for a building 100 x 200 feet, and a decision to put up this structure was reached at the annual stockholders' meeting, held a few days ago. This plant will replace the one destroyed by fire in October, 1907, and will supplement the company's plant at Cleveland and Milwaukee. This company

is incorporated for $175,000. Officers are: President, H. E. Mills; vice president, Thomas Wheatley; treasurer, M. A. Rausch; secretary, Frank S. Scoville. These together with J. L. Cheney, W. E. Beard and M. H. Phillips, make up the list of stockholders.

A five-ton Newten cupola, built by the Northern Engineering Works, Detroit, has been installed in the North plant of the Chickasaw Iron Works, Memphis, Tenn. This is the fourth cupola of this design in the works of this concern.

The Albany & North River Molding Sand Co., Albany, N. Y., miner and shipper of molding sand, has issued a handsome calendar with figures of large size which can be seen at considerable distance.

The Whiting Foundry Equipment Co., Harvey, Ill., has appointed the following agents: The United States Steel & Equipment Co., Seattle, for Vancouver, Portland and the state of Washington; Gorman, Clancy & Grindley, Ltd., Calgary, Alberta, B. C., for the province of Alberta and the southwestern section of British Columbia.

The Pittsburg White Metal Co., Pittsburg, which has been operated under a limited partnership for about 20 years, has been incorporated under the laws of Pennsylvania. The officers are R. E. Rinehart, president, and E. E. Rinehart Jr., secretary and treasurer.

The Ross-Tacony Crucible Co., Tacony, Pa., manufacturers of crucibles and other similar products, has established an office at Chicago, at 348 Railway Exchange building.

The Harrison Supply Co., Boston, importer of chilled steel shot for sand blast use, has sent out a very handsome calendar, "The Pride of Kentucky," accompanying it by a cheery note carrying the season's greetings.

The Northern Engineering works, Detroit, furnished the crane equipment recently installed in the plant of H. Brewer & Co., Tecumseh, Mich. It consists of two 8-ton cranes having a span of 30 feet, two 5-ton cranes, one 8-ton pillar crane, and several trolleys and hoists for overhead I-beam tracks.

Gulick-Henderson & Co., Pittsburg, inspecting engineers, foundry specialists and chemists, have established a western office and laboratory in the Manhattan building, Chicago, which is in charge of W. O. Collins, who has recently become a member of the firm. He was formerly connected with Collins & Stevens, who were engaged in inspection and general engineering work.

The American Molding Sand Co., Columbus, O., has been incorporated with $25,000 capital by W. B. Kizer, C. S. Rose, H. M. Freck, J. A. Tingle and T. M. George. This concern will operate molding sand pits near Zanesville and at other points in the northern part of Ohio. It is also the intention to produce Zanesville red machinery sand and Zanesville fine sand. Two mills will be erected for grinding molding sand, each having a capacity of eight to 10 carloads per day.

The Metal Dross Economy Co. has been organized at Bristol, Conn., to manufacture a device for recovering metal from brass skimmings. By its use it will be possible to separate the charcoal from the metal and oxide. The clean metal is also removed and is easily reclaimed. A. L. Haases is president and sales manager, and W. H. Carpenter, vice president and general manager.

The Hill & Griffith Co., Cincinnati, manufacturer of foundry supplies, has increased its capital stock from $100,000 to $150,000. The increased capital is to provide for improvements and extensions which will be made in the near future.

Geo. F. Smith has been elected president of the Joseph Dixon Crucible Co., Jersey City, N. J., to succeed the late E. F. C. Young.

Wm. F. Beckman, who was employed in the capacity of demonstrator and patternmaker by the E. H. Mumford Co., Philadelphia, during the past three years, has been placed in charge of the metal pattern department of the Abram Cox Stove Co., Philadelphia.

E. E. Brosius, sales manager of the Morgan Engineering Co., Alliance, O., has resigned.

T. S. Taggart, general superintendent of the Missouri Malleable Iron Works, East St. Louis, Ill., has resigned and has been succeeded by H. T. Pero, of Brantford, Can.

AN IRON AND STEEL DEPARTMENT STORE.

Joseph T. Ryerson & Son, Chicago, have issued a handsomely illustrated 46-page brochure, which is devoted to a description of this concern's new plant. Practically every conceivable rolled steel product is carried in stock, as well as many lines of machinery necessary in the manufacture of finished goods, and this ability to fill practically every requirement has resulted in this plant being known as a department store for the iron and steel consumer. The warehouses cover an area of 750,000 square feet and have a capacity of 150,000 tons.

PHILADELPHIA ASSOCIATED FOUNDRY FOREMEN.

At the monthly meeting of the Associated Foundry Foremen of Philadelphia, held Jan. 12, reports of experiments made by changing the method of charging cupolas, as suggested by Dr. Richard Moldenke at the December meeting, were submitted, and without exception the foremen reported that the coke consumption had been materially reduced. Lighting cupolas by the use of fuel oil sprinkled on the coke was also favorably reported on.

SILVERY IRON.

An important change has been made in the sliding scale of prices of silvery pig iron by the Jackson county, O., blast furnaces. There will be an advance in price hereafter with every one-half of 1 per cent of the silicon content. Up to and including 10 per cent silicon the difference will be 25 cents per ton, and above 10 per cent, 50 cents per ton for each one-half of 1 per cent silicon content. To illustrate this more clearly and give the range of silicon content to be understood in contracts, the following table is presented, which is based on the present market price of $18.50 furnace for 8 per cent silicon:

Per cent.	Silicon will range per cent.			Price.
4	3.75	to	4.25	$16.50
4½	4.25	to	4.75	16.75
5	4.75	to	5.25	17.00
5½	5.25	to	5.75	17.25
6	5.75	to	6.25	17.50
6½	6.25	to	6.75	17.75
7	6.75	to	7.25	18.00
7½	7.25	to	7.75	18.25
8	7.75	to	8.25	18.50
8½	8.25	to	8.75	18.75
9	8.75	to	9.25	19.00
9½	9.25	to	9.75	19.25
10	9.75	to	10.25	19.50
10½	10.25	to	10.75	20.00
11	10.75	to	11.25	20.50
11½	11.25	to	11.75	21.00
12	11.75	to	12.35	21.50

Charles A. Brayton, president of the Standard Car Wheel Co., died Dec. 24, at his home in Cleveland, aged 66 years. Death was due to apoplexy. Mr. Brayton had a wide experience in the foundry business, having been a partner in the firm of Maher & Brayton for 25 years until it was absorbed by the National Car Wheel Co. He then organized the Standard Car Wheel Co., together with his two sons, W. B. Brayton and C. A. Brayton Jr.

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Specifications for Foundry Iron

The proposed specifications for foundry iron prepared by a committee appointed by the Philadelphia Foundrymen's Association, embody many new features that should be incorporated in a revised standard that is now being considered jointly by the American Foundrymen's Association and the American Society for Testing Materials. Brevity and conciseness should be sought for in all specifications, and it is refreshing to note that the few clauses contained in the specifications drawn up by the Philadelphia committee are to the point and are intended to avoid all possibility of misunderstanding between buyer and seller. The symbols which represent every possible variation in the contents of the various elements will furthermore effect a great reduction in the telegraph tolls, and this at least should meet with the hearty approval of the pig iron producers and merchants. As a basis for market quotations a grade has been established to be known as "No. 2," which shall be of a quality of metal similar to the foreign standard grading upon which warrants are issued, and analyzes as follows: Silicon, 2.50 per cent and over, and sulphur, 0.04 per cent and under.

Exhibit of Foundry Equipment

The exhibit of foundry supplies and equipment which will be held in Cincinnati concurrently with the annual convention of the American Foundrymen's Association should, for several reasons, surpass in interest any of the shows heretofore conducted by the supply and equipment makers. The past year has witnessed revolutionary changes in foundry practice, accomplished largely by the use of improved molding machines and other devices, which have been potent factors in reducing foundry costs. Practically all of the builders of these tools are preparing to make displays and practical demonstrations will be made of the work they can produce. Numerous furnaces for melting the softer metals have also been introduced to the foundry trade in the last six months, and facilities will be provided for showing them under actual operating conditions. A show of this kind provides great educational advantages and the exhibitors should be at least partly repaid for their efforts and heavy expenditures by the attendance of all those interested in the production of castings. Owing to the great cost involved in the conduct of these exhibits, it has been suggested that a nominal admission fee be charged to all visitors, regardless of affiliations with allied associations. This policy is pursued by nearly all of the organizations conducting trade shows, and while the revenue to be derived in this way only covers a small portion of the expense, nevertheless, it somewhat reduces the burden on the individual exhibitors. It is roughly estimated that the expenditures of manufacturers of foundry supplies and equipment at Toronto aggregated not less than $50,000, and a large portion of this amount went to defray the cost of the show and transportation charges to and from Canada.

Trade Outlook

Foundry trade conditions have not perceptibly improved during the last 30 days, and jobbing founders are naming exceedingly low prices to secure the tonnage that is offered from time to time. From the quotations made in all of the leading centers it is evident that heavy losses are being incurred by some foundrymen in their zeal to keep their plants in operation. Some of the prices named barely cover the cost of the iron in the castings, and much miscellaneous work of a difficult nature is being taken on a basis of one price for the entire lot. The adoption of uniform cost-keeping methods by the jobbing, malleable and steel founders was intended to prevent another era of price cutting, but it is apparent that the systems are by no means generally applied, or are being ignored by some who have made their cost-keeping records conform to these standards during the past few years. While no excessive profits can possibly be earned as long as the tonnage is below normal, nevertheless, fair prices should prevail and should be asked by all foundrymen, that will at least cover operating costs and carry fixed charges. Pig iron quotations remain practically unchanged, despite the lull in demand. Makers of cast iron pipe are the heaviest buyers, one contract for 20,000 tons having recently been placed with southern producers. Quotations in the leading iron centers are as follows: Standard No. 2, Philadelphia, $17.25; No. 2 southern, Cincinnati, $16.25; No. 2 southern, Birmingham, $13.00; local No. 2 foundry, Chicago, $17.35; Lake Superior charcoal, Chicago, $19.50; northern No. 2 Cleveland, $16.50; No. 2 foundry, Pittsburg, $16.40. Large contracts continue

to be placed by automobile builders with brass founders, who, with few exceptions, are operating their plants at full capacity. The softer metals, notably copper and lead, continue to decline.

PRIZE CONTEST AWARDS.

Owing to the large number of contributions entered in the prize contest conducted during the last three months by THE FOUNDRY, the announcement of the awards will have to be deferred one month, and will be made in our March number.

PERSONAL.

James M. Swank, who has been executive head of the American Iron and Steel Association for 36 years, with headquarters at No. 261 South Fourth street, Philadelphia, has tendered his resignation to be effective as soon as his successor is appointed. During the past 22 years Mr. Swank served in the capacity of secretary and general manager and practically all of the work of this organization was carried on under his guidance.

H. C. Thomas, who has been connected with the Coosa Pipe & Foundry Co., Gadston, Ala., for a number of years, has been appointed superintendent of the concern to succeed W. R. Moore, resigned.

C. F. Brown, formerly vice president of the Kawin Co., Chicago, and who was also at one time connected with the Griffin Wheel Co., has been appointed superintendent of the Modern Foundry Co., Oakley, Cincinnati, O. Mr. Nellis, who was also formerly connected with the Kawin Co., will assist Mr. Brown temporarily.

David S. Hawkins, mechanical engineer, has established an office at 1021 Rose building, Cleveland, and will engage in consulting work and will make examinations and reports upon all phases of foundry practice relating to buildings, transportation, distribution, storage, power, supplies, melting, molding, piece work, premium work and molding machines.

Mrs. Frances A. W. McIntosh, formerly advertising manager of the Buffalo Forge Co., Buffalo, has resigned and will engage in the preparation and printing of advertising literature. Headquarters have been established at 103 Anderson place, Buffalo.

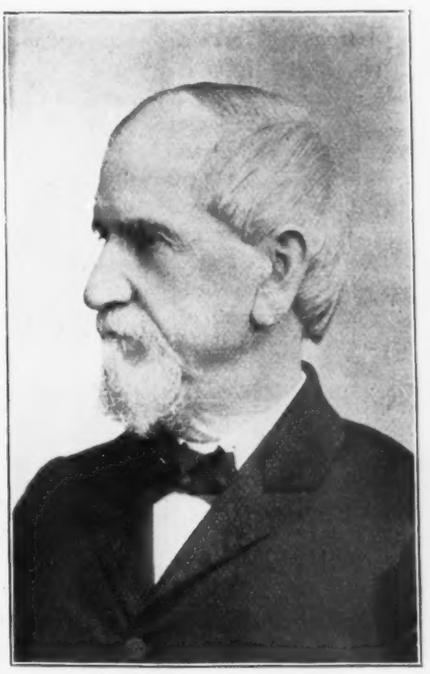
W. S. McQuillin, president of the Associated Foundry Foremen, formerly connected with the Allegheny Foundry Co., Warren, Pa., has been placed in charge of the molding machine department of the Wood Working Machinery Co., Rochester, N. Y.

Arthur L. Stevens, the well known industrial and furnace engineer, is now associated with the Rockwell Furnace Co., 26 Cortlandt street, New York city. Mr. Stevens has had a wide experience in the construction and operation of oil and gas furnaces for melting and heating purposes.

John E. McMinn, formerly superintendent of the Detroit Stove Co., Detroit, has been appointed general manager of the Lincoln Stove & Range Co., Fremont, O.

Charles G. Robinson has been appointed superintendent of the foundry of the Chicago Steel Foundry Co., Chicago.

C. S. Lovell, secretary of the E. H. Mumford Co., Philadelphia, manufacturers of molding machines, since its organization, has resigned to accept a position with Baxter D. Whitney & Son, Winchendon, Mass. He will be succeeded by E. M. Huggins, who has been chief draftsman of this concern since its organization.



STANLEY G. FLAGG, SR.

W. J. Adams, who has had a wide experience in the foundry supply trade throughout the west, has associated himself with the Federal Foundry Supply Co., Cleveland, and is in charge of the western office and warehouse, 285 to 289 Oregon street, Milwaukee. This concern manufactures Bright's core binders, foundry flour, various kinds of East Indian plumbago, blacking, seacoal, core washes, etc.

H. E. Herr has assumed the position of general manager of the Westinghouse Machine Co., East Pittsburg, Pa.

Frank Knore, formerly assistant superintendent of the Modern Foundry Co., Cincinnati, has been appointed superintendent of the Sheboygan Falls Foundry & Machine Co., Sheboygan Falls, Wis.

J. J. McDevitt, formerly affiliated with the equipment department of the S. Obermayer Co., Cincinnati, and until recently connected with the Tabor Mfg. Co., Philadelphia, has been placed in charge of the Milwaukee office of the S. Obermayer Co.

Thomas Hopwood has been appointed foreman of the plant of the Majestic Furnace & Foundry Co., Huntington, Ind. Mr. Hopwood was formerly assistant foreman of the Wabash shops at Moberly, Mo.

RETIREMENT OF STANLEY G. FLAGG, SR.

Stanley G. Flagg Sr., whose name has been prominent in the malleable foundry industry for many years, retired on Jan. 1 from the firm of Stanley G. Flagg & Co., Philadelphia, which he founded in 1856, and with which, until recent years, he has been actively identified. Mr. Flagg was born in Whitesboro, N. Y., March 13, 1830, and spent the early years of his life in Boston. After some experience in Philadelphia in the dry goods trade, he investigated the manufacture of malleable pipe fittings and established a plant in Frankford, a suburb of Philadelphia. The manufacture of malleable castings more than half a century ago involved many difficulties, and to the untiring efforts of Mr. Flagg much of the progress recorded in this trade is due. In 1860 he built shops at Front street and Girard avenue, Philadelphia, and in 1865 purchased a site at Nineteenth street and Pennsylvania avenue, where a second plant was built which was enlarged and rebuilt in 1879. Both works are still the property of the firm. The Pottstown plant was placed in operation in 1896. The manufacture of small steel castings was taken up by this concern in 1873, and samples were exhibited at the Franklin Institute fair in 1874 and a bronze medal was awarded to the concern for its efforts in exploiting this field. A further exhibit was made at the Philadelphia Centennial exhibit in 1876 which was likewise recognized by a medal. Upon Stanley G. Flagg Jr., who has been associated with his father since 1882, now devolves the sole management of the business.

FOUNDRY & PATTERN SHOP EQUIPMENT

Automatic Molding Machine---Turbine Blower Set---Floor Controlled Electric Traveling Crane---Chain Belt-Driven Tumbling Mill---Air Compressors---Combined Molding Bench and Ladle Carriage---Large Jarring Molding Machine --- Paxson-Deemer Side Blow Converter

THE automatic molding machine built by the Arcade Mfg. Co., Freeport, Ill., described in the June, 1908, issue of THE FOUNDRY, has been practically redesigned and rebuilt and many improvements have been added. The operating end of the machine is shown in Fig. 1, the sand trough and conveyor in Fig. 2, and a rear view, showing the cope and drag on the conveyor before the mold has been closed, is illustrated in Fig. 3.

On the improved automatic machine, power is transmitted by means of a rope cable drive which takes up the lost motion ordinarily encountered in the use of the link chain and gear drive. The tension of the cable is kept constant by means of a weighted idler, and by the use of a countershaft and gears outside of the machine, it now requires 25 per cent less power to operate than heretofore. The strike-off which automatically scrapes the superfluous sand from the top of the flask has been improved by adding a double action device which shortens the length of the strike-off and makes the machine more compact.

For carrying away the superfluous sand from the flasks a belt is now used in place of a worm conveyor. A rotary riddle was used on the lower part of the first machine before the sand was conveyed to the operator. This has been replaced by a flat riddle in the hopper shown above the machine. The operation of the shaking grate at the bottom of the hopper has been simplified, and power is now applied direct from the countershaft instead of by direct transmission. The riddle at the top of the hopper is operated by a crank movement through two broken links. This gives the riddle a horizontal as well as a vertical movement, and all refuse is thrown from the riddle into the chute attached to the side of the hopper shown in Fig. 1. All of the working parts are enclosed so that no sand or refuse can come in contact with them.

In Fig. 2 is shown a sand trough and conveyor which has been developed in the foundry of the Arcade Mfg. Co., not only for use on this machine, but which, together with the hopper, can be used to advantage on molding machines of other types to facilitate the handling of sand. This trough is made in sections, 6 feet long, and is provided with a reciprocating hoe conveyor. Power is applied from the crank shaft at the bottom of the conveyor which delivers

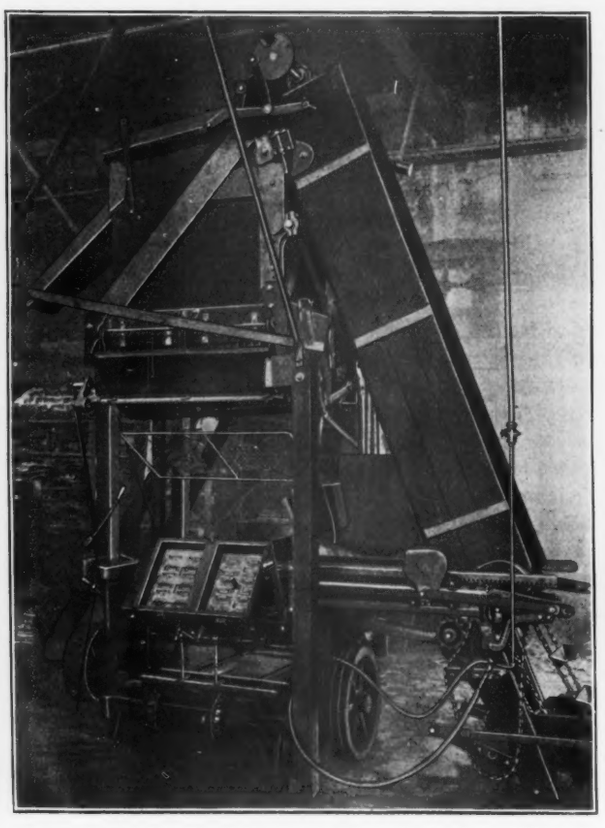


FIG. 1—OPERATING SIDE OF ARCADE AUTOMATIC MOLDING MACHINE, SHOWING FLASKS ON PATTERN PLATES

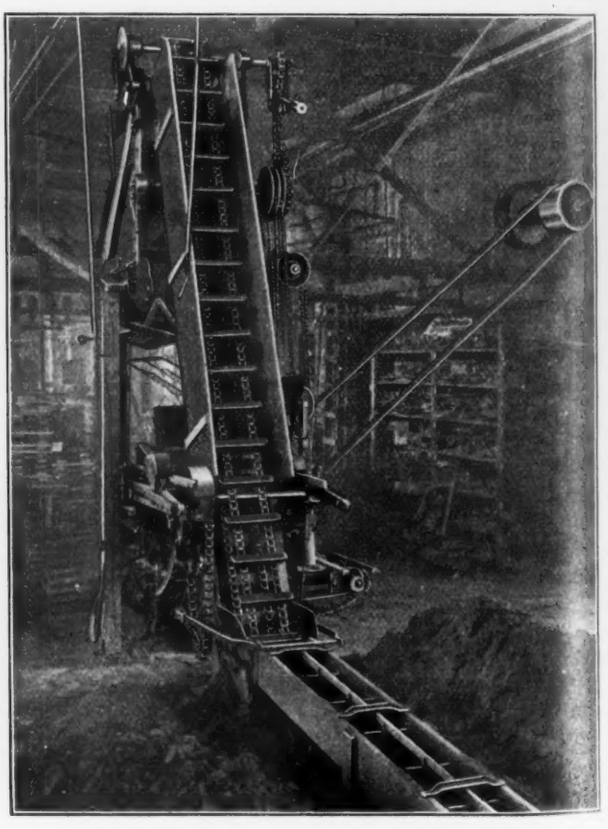


FIG. 2—SAND TROUGH AND SAND CONVEYOR OF ARCADE AUTOMATIC MOLDING MACHINE

the sand to the hopper. By the use of this trough, which can be extended to any desired length, the sand is carried to the molding machines from the points where the castings were shaken out, thereby reducing the handling of this material by the molder, and effecting an increase in the output of finished molds of about 25 per cent. The conveyor consists of a link belt to which buckets are attached and power is transmitted from a shaft at the bottom of the conveyor. The sand is carried in the buckets facing the open side of the trough, and in this way is not rubbed against the back of the conveyor enclosure, which is merely intended to prevent the sand from falling from the buckets onto the molding machine.

When operating the machine, snap flasks are placed in position on the cope and drag pattern plates, shown in Fig. 1, which are then in a horizontal position. By the movement of a lever sand is permitted to drop from the hopper into the flasks, a distance of about 4 feet. To break the drop of the sand, and to prevent its packing too firmly against the center of the pattern, screens are provided, as shown in Fig. 1, suspended at a point about 3 feet above the pattern plates. After the flasks have been filled, the automatic strike-off moves forward and removes the superfluous sand, which is carried by a belt to the boot of the conveyor. The cope and bottom boards are then adjusted, the mold is rammed and the patterns are vibrated. The operator next adjusts the automatic clamps on the flasks, the molds are rolled over and are deposited on a carrier shown at the bottom of the machine, Figs. 1 and 3. When the flasks are rolled over another set of pattern plates, duplicates of the first, are in position on the machine for receiving the flasks and making the cope and drag halves of the mold. After the clamps have been removed from the flasks, the patterns are drawn and the operator proceeds to make another mold, repeating the cycle of operations outlined. In the meantime the cope and drag have been delivered to the rear of the machine on the carrier as shown in Fig. 3. The mold is closed and the snap flasks are removed by a helper who also deposits the molds on the floor.

Two sets of snap flasks are required, and when operated at its full capacity with a sufficient force of men to carry away the molds, it is possible to make 180 molds an hour.

The application of a sand trough, conveyor and hopper to a squeezer and a Modern molding machine is shown in Fig. 4. In Fig. 5 the Modern machine is shown on one side of the hopper, and the squeezer on the other side is illustrated in Fig. 6. The sand is dropped from the hopper onto the shelf which is on a level with the tops of the flasks which the operator fills by hand.

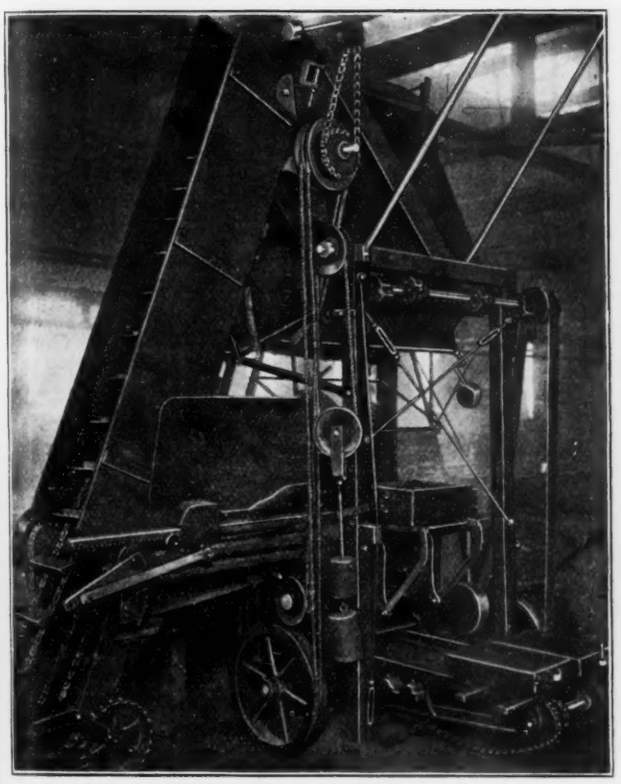


FIG. 3—REAR VIEW OF AUTOMATIC MOLDING MACHINE, SHOWING COPE AND DRAG ON CONVEYOR

FIG. 4—SAND TROUGH, CONVEYOR AND HOPPER FOR SQUEEZER AND MODERN MOLDING MACHINE

A MOLDING MACHINE DEMONSTRATING PLANT.

The E. H. Mumford Co. has recently completed at its new location, 1223-25 Spring street, Philadelphia, a very complete show room for the exhibition and demonstration of the molding machines manufactured by this concern and by Ph. Bonvillain et E. Ronceray, Paris. Facilities are provided for the operation under actual conditions, of the principal styles of both the French and their own American machines.

A power plant in the cellar includes a motor-driven air compressor made by the Chicago Pneumatic Tool Co. and a Watson-Stillman hydraulic pump, also motor-driven. The accumulator, storing 750 pounds pressure, is located in the yard and the water is kept from freezing by the use of wood alcohol, about 10 per cent being added.

The greater part of the show room is given over to the French machines, one each of the following being in place: A6, for ramming molds up to 14 x 20 inches; A5, up to 18 x 22 inches; A3, up to 22 x 32 inches; R3, a power roll-over machine for use with the A3 machine, the former making drags while the latter makes the copes where it is

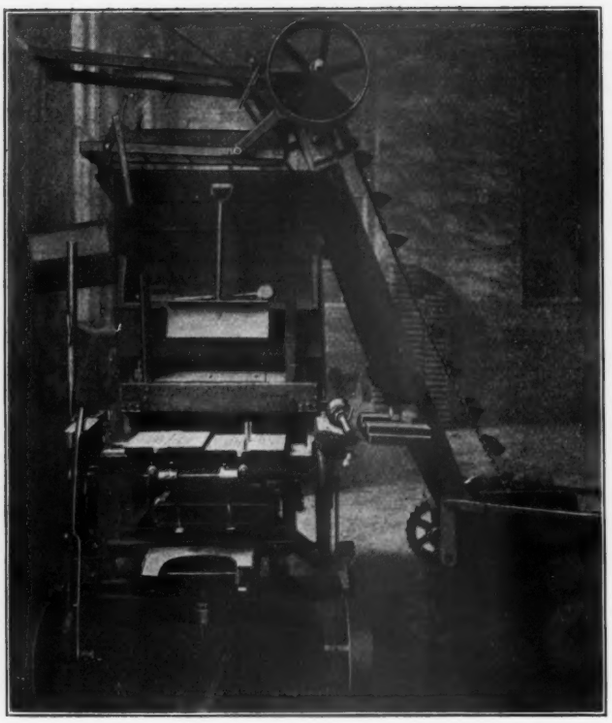


FIG. 5—MODERN MOLDING MACHINE ON ONE SIDE OF SAND HOPPER

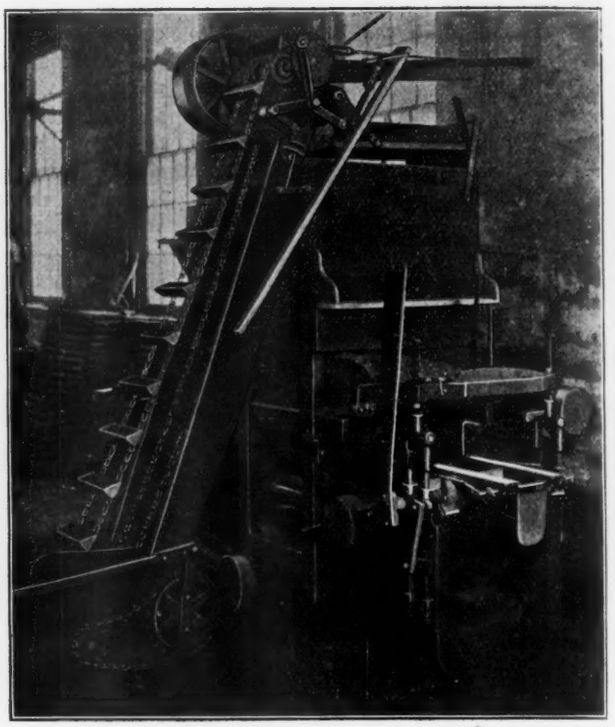
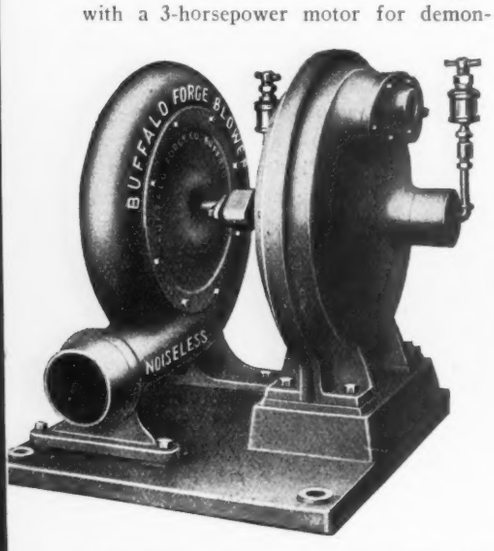


FIG. 6—SQUEEZER ON OPPOSITE SIDE OF SAND HOPPER

necessary to roll over drags; R4, a hand roll-over machine which pairs off with an A4; and a B4 machine especially designed for ramming deep cheeks, its capacity being 18 inches in diameter or square. All these machines may be used in connection with an assembling machine to close copes and drags over deep cores, where the metal is thin. The assembling machine is also employed to strip molds out of flasks and thus produce snap molds from solid flasks. Two Mumford machines are in position, one a 13 x 18-inch split pattern and the other a 12-inch power rammer.

A large sand mixing and rubbing mill, also of French manufacture, is equipped with a 3-horsepower motor for demonstration purposes. This machine has already been described in THE FOUNDRY, as have most of the molding machines shown. It consists of an inclined revolving cast iron cylinder, 9 feet long and 25 inches inside diameter, and fitted with four longitudinal cast iron rollers of different diameters. The action on the sand is entirely one of rubbing. The sand is put through in a tempered state, and a very intimate mixture is secured. Fifty per cent of sharp sand added to ordinary strong heap sand provides after treatment, a sand that is ideal for the most difficult green sand molding.

The show room is a one-story structure about 20 x 30 feet, well provided with skylights. The floor is concrete, hydraulic piping being accommodated in troughs covered with planking. Facilities are provided for making white metal patterns and stripping plates for use on the French machines and for the manufacture of pattern plates.

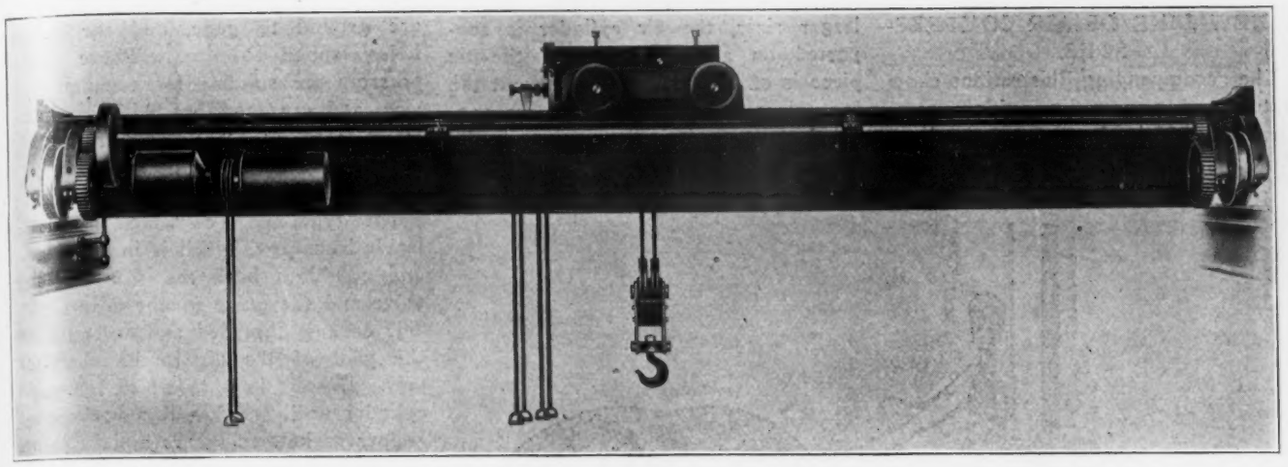


BUFFALO FORGE TURBINE BLOWER SET

A NEW BLOWING UNIT.

The advantages of direct-connected units are being more generally appreciated and the field for units of this kind is constantly expanding. The application of the prime mover and the machine as one unit is now being extended to almost every piece of mechanism of sufficient size and importance to warrant it. The steam turbine is an ideal engine for direct connection where high speed is essential, thus particularly adapting it to blowing service. The new blowing unit shown in the accompanying illustration, built by the Buffalo Forge Co., Buffalo, embodies all of the advantages of direct connection. It consists of a steel pressure blower connected to a steam turbine mounted on a rigid cast iron base. The turbine requires practically no attention, is self-lubricating throughout and is entirely enclosed in a dust-proof case. The extremely high speed at which the turbine operates permits the use of smaller fans to secure and maintain the required pressure. The blower consists of a seamless cast iron shell and a heavy steel plate blast wheel mounted on a rigid hub or spider. On the smaller sizes the blast wheel is hung directly on the turbine shaft, thus doing away with all the bearings on the fan. On the larger sizes, oil ring bearings are used to prevent any undue strain on the turbine shaft. Being direct-connected there is no possibility of any parts of the mechanism getting out of alignment.

Among the recent orders closed by the Northern Engineering Works, Detroit, are the following: One five-ton Newten cupola, Rackingham Foundry & Machine Co., Rackingham, N. C.; one three-ton Newten cupola, Interstate Drainage & Investment Co.; one No. 42 Newten cupola, Cadillac Machine Co., Cadillac, Mich.



FLOOR CONTROLLED ELECTRIC TRAVELING CRANE

A FLOOR CONTROLLED ELECTRIC TRAVELING CRANE.

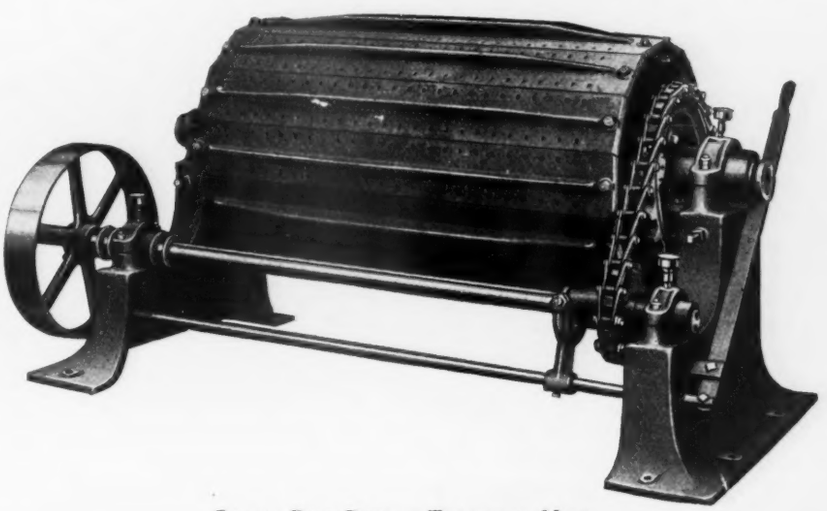
The floor controlled electric traveling crane, shown herewith, is especially useful in foundries and other shops in moderate capacities ranging from one to five tons with spans from 12 to 40 feet. It can be made in either one, two or three motor designs. It consists of a double girder bridge on which travels a trolley supporting a Northern, Junior type, electric hoist. The trolley is so arranged that it may be operated in either high, medium or low positions, thus readily adapting it to any height of ceiling, or any established distance from rail to truss. The hoist is equipped with mechanical and electric brakes and has an automatic limit stop for block. Any type motors can be used and they may be either direct or alternating current.

The electric brake is so designed that it acts at once if the current is broken. The mechanical brake not only assists in holding the load but aids in controlling the lowering operation. The automatic limit stop does not depend upon the hoisting ropes for operation, but is controlled by a positive screw. The hoisting gears are of the spur gear type enclosed entirely of the spur oil tight case. The controllers have ample resistance for a wide range of speed, thus making the crane well adapted for work over foundry floors. The crane is usually controlled from the floor either by controller ropes or levers, but it can be arranged for control either from a cab attached to the bridge or from a fixed pulpit on the floor. It is well adapted for installation in the bays of large buildings or in the main floors of smaller buildings. The crane is manufactured by the Northern Engineering Works, crane builders, Detroit.

CHAIN BELT-DRIVEN TUMBLING MILL.

A tumbling mill driven by an interlocking chain belt, built by the Chain Belt Co., Milwaukee, Wis., is shown in the accompanying illustration. Owing to the large amount of dust usually present in cleaning rooms, the wear on gears by which these mills are usually driven is unusually heavy, whereas the wear on the chain is reduced to the minimum. The large sprocket rim is bolted onto the end of the drum of the mill and is made in halves to facilitate its removal without disturbing the end housing. The driving sprocket on the center shaft has a spiral clutch attached, which is thrown in and out for starting and stopping the machine by the movement of a lever at the side. The links of the chain are made of malleable iron, riveted together, and are made to withstand severe service.

Crucible fuel oil furnaces manufactured by Alfred Fisher, 103-7 West Monroe street, Chicago, for melting non-ferrous metals, have been installed in the following plants: Penberthy Injector Co., Windsor, Can.; Somerville Limited, Toronto, Can.; Canadian Wolverine Co., Chatham, Ont.; Detroit—Clayton & Lambert Mfg. Co., Detroit Sanitary Co., Eclipse Foundry Co., Sherwood Brass Works, Detroit Lubricator Co., Penberthy Injector Co., Capitol Brass Works and American Injector Co.; Milwaukee—Milwaukee Valve Co., Milwaukee Bronze Castings Co., Rundel & Spence; Frost Mfg. Co., Kenosha, Wis.; Aluminum Mfg. Co., Two Rivers, Wis.; Ferd. Messmer Mfg. Co., St. Louis.; J. L. Mott & Co., Trenton, N. J.; Mark Mfg. Co., Evanston, Ill.; Western Electric Co., Hawthorne, Ill.; Chicago—Federal Co., Findisen, Kropf & Co., W. D. Allen Mfg. Co., J. Lowenthal & Sons, N. Deutsch & Co., A. H. Anderson Brass Works, Crane Co., Willy H. Lau & Co., Acme Metal Mfg. Co., Standard Metal Mfg. Co., Liquid Carbonic Co., Hewitt Mfg. Co., and L. Wolf Mfg. Co.



CHAIN BELT-DRIVEN TUMBLING MILL

A NEW LINE OF AIR COMPRESSORS.

The accompanying illustrations show features of a new line of air compressors which have recently been placed on the market by the Thos. H. Dallet Co., Philadelphia. These compressors have developed several new ideas in compressor design. All parts requiring adjustment or renewals are readily accessible and a liberal amount of metal has been used where needed to insure rigidity in operation.

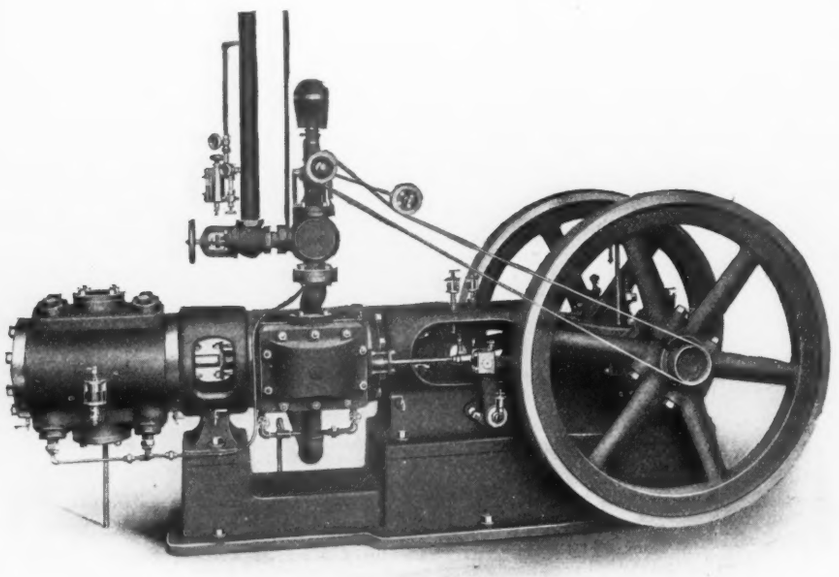


FIG. 1—SINGLE STEAM-DRIVEN COMPRESSOR

The frame is of the open fork center crank type, and is of massive design to permit on each size of compressor, when desired, a greater range of capacity by substituting a cylinder of the next larger size than the standard to operate at 100 pounds pressure. Thus, a 10-inch cylinder may be placed on an 8-inch compressor frame, giving somewhat increased capacity at slightly greater first cost. The line of compressors designed comprise both steam and belt-driven machines of the straight line and duplex types. In the case of duplex compressors with compound steam cylinders, a reducing valve has been inserted between the high pressure steam pipe and the low pressure cylinder, enabling live steam to be fed to the low pressure cylinder for starting purposes, when the high pressure cylinder has stopped on a dead center.

Air and steam cylinders are tied together and held in position, by means of an internally flanged distance piece. On the smaller sizes, this piece supports the air cylinder, but on the larger sizes, the air cylinder is supported on a pedestal, while the tie piece is of circular section without the foot piece. Ample openings are provided to permit adjustment of the stuffing boxes and tightening of the cylinder stud nuts. In the air cylinders, clearance space is reduced to a minimum, and all heads and cylinder walls are water jacketed. Means are provided for draining the cylinder and cylinder head jackets, an essential in cold weather. Lubrication is effected by feeding oil into the intake passage, whence it is carried by the suction into the cylinder in the form of a spray. Mechanically-operated inlet valves are supplied on all sizes of compressors, when desired. The valves are ground to gage, and the valve holes lapped to size. These compressors are suitable for vacuum service, and are furnished with mechanically-operated inlet valves for high vacuum.

The intake valve is of the automatic poppet type, and is contained in a malleable iron cage, which is in one piece and combines both the seat for the valve and the guide for the valve stem. The cage is threaded and screws into the wall of the air intake chamber only. It seats in a recess of the main cylinder wall, and has thin corrugated copper gaskets to secure a tight joint. The valve cage cap acts as a lock nut for holding the cage in place after it has been screwed down to its seat in the cylinder. In the case of a compound machine, corrugated copper gaskets are placed under the valve cage caps on the high pressure cylinder to insure against any leakage. The valve proper is a hardened special alloy steel, with seat and stem ground to gage. The spring holder comprises a split taper ring set into a recess on the valve stem and held together and tight to the stem by means of a solid taper ring slipping down over it. The hammering of the valve on its seat tends to tighten the spring holder on the stem instead of driving it off. This eliminates any tendency of the spring holder to shear off or work loose from the stem. The discharge valve is of the automatic poppet type, and is contained in a valve cage of malleable iron. The method of seating in its cylinder and locking to its seat is identical with that of the intake valve.

The inter-cooler is of large cooling area, and employs the return flow type

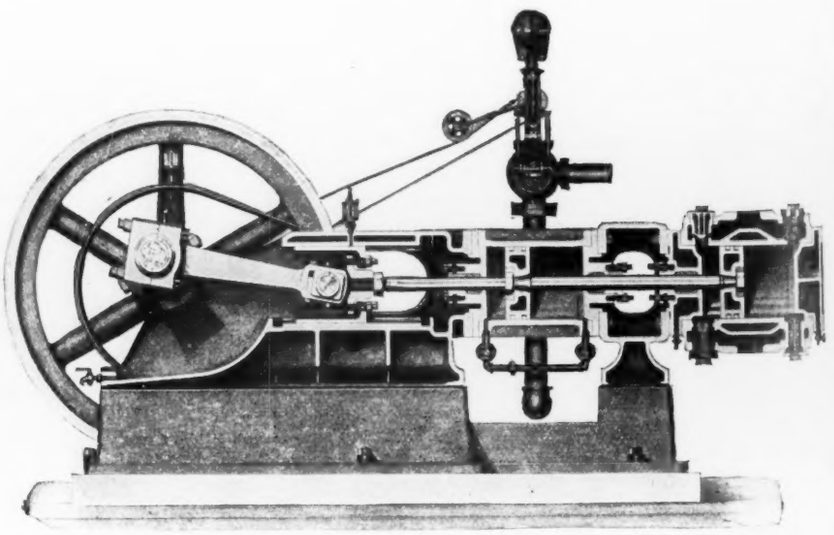


FIG. 2—SECTIONAL ELEVATION OF SINGLE STEAM COMPRESSOR

of water circulation. Baffle plates are used to deflect the flow of air and aid in its effectual contact with the cooling tubes. This method reduces the air temperature between stages to approximately the original temperature and tends to reduce the final or discharge temperature and also the horsepower required for a given capacity. The nest of cooling tubes may be removed intact from the inter-cooler box without disturbing any of the piping. The inter-cooler is supplied with a pop safety valve pressure gage and drain valve.

The belt-driven machines are provided with an unloading device, which automatically unloads the air cylinder. When a predetermined pressure is reached in the receiver, one or more inlet valves at both ends of the cylinder are held open and the load is taken off of the compressor, allowing it to run light until the pressure drops in the receiver, upon which the valves are released and compression resumed. On the steam machines, a combined speed and pressure governor is used, which unloads the air exactly the same as on a belt-driven machine, and, at the same time, controls the speed, allowing a single steam machine to just turn over when unloaded and bringing a duplex or compound machine to a dead stop.

The steam cylinder and valve gear of the steam-driven machines give a high efficiency with slight attention. A plain balanced D slide valve is used on the small and medium sized machines, while a Meyer balanced adjustable cut-off valve is employed on the larger machines. The steam cylinders are lagged with mineral wool. On all steam-driven machines the governor is equipped with a safety stop device, which will stop the machine, if the governor belt breaks.

The cross head is a new type box pattern of semi-steel. The shoes are adjustable and have large bearing surfaces. Side bearings allow easy access to the cross head shoe binder bolts. The cross head pin is fitted to tapered seats in the cross head, drawn tight on the tapers by means of a nut held in position by a pin. The connecting rod is of the marine type, and is adjustable at the cross head end by means of a split box. The crank pin end is adjusted by removable tin liners. The crank shaft is forged from a solid billet of open-hearth steel, and in case of a duplex shaft, the portion in the center is enlarged to accommodate the heavy flywheel.

The compressors are built in sizes ranging from 8-inch stroke up to and including 16-inch stroke, and give a range of capacity of 79 cubic feet of free air per minute up to 1,200 cubic feet.

FIG. 1—CARRIAGE USED AS A MOLDING BENCH

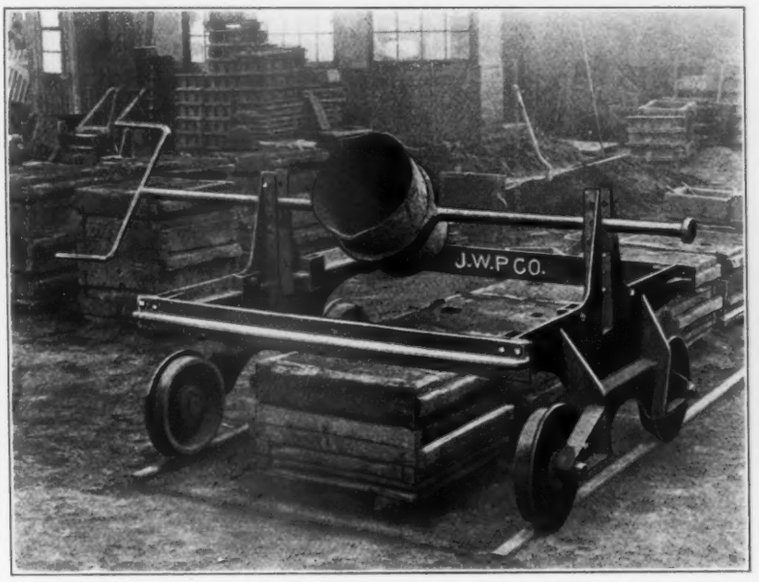


FIG. 2—CARRIAGE ARRANGED FOR HANDLING LADLE

A COMBINED MOLDING BENCH AND LADLE CARRIAGE.

A novel, combined molding bench and ladle carriage, built by the J. W. Paxson Co., Philadelphia, is shown in Figs. 1 and 2. When used as a bench, Fig. 1, it is easily moved along the floor as the day's work progresses, and in Fig. 2 the front bar is shown removed and the shank of the ladle is resting on the two center uprights. To facilitate the backward and forward movement of the ladle, the shank rests on wheels inserted between the upright supports. By the use of this device one man only is required for pouring off a ladle holding 600 pounds of iron. The width of track recommended by the manufacturer is from 5 to 6 feet.

The Crescent Emery - Corundum Wheel Co., Indianapolis, succeeds the Rupert Co., which was engaged in the manufacture of corundum wheels for grinding purposes. The officers of this concern are R. O. Rupert, president; Chester G. Browne, vice president and treasurer, and R. O. Rupert Jr., secretary and general superintendent.

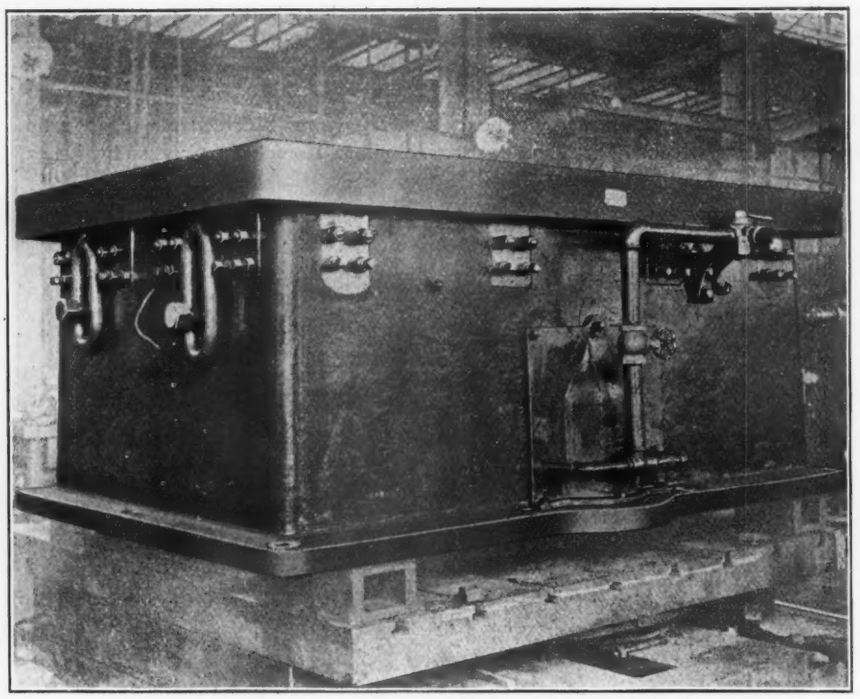


FIG. 1—LARGE HERMAN JARRING MOLDING MACHINE. TABLE, 6 x 9 FEET

A LARGE JARRING MOLDING MACHINE.

The Herman Pneumatic Machine Co., Zelienople, Pa., recently completed a large jarring molding machine equipped with a table plate 6 x 9 feet. This is the largest machine yet made by this concern, and a successful demonstration of its operation was conducted at the Frank-Kneeland plant of the United Engineering & Foundry Co., Pittsburg, on Saturday, Jan. 16. The machine is for installation in the plant of the Modern Foundry Co., Oakley, near Cincinnati, O. The table of the machine shown in Figs. 1 and 2, is 2½ inches thick and is braced underneath by eight ribs, 6 inches deep and 2 inches wide. The plate is made of cast steel and is provided with an apron which encircles its edge and effectively prevents the sand from falling into the interior of the machine. The flask used when the demonstration was made was 3 feet 6 inches x 4 feet x 8 feet, and weighed 3½ tons. The pattern was that of a stand used for rolling mill work. Including the filling of the flask, rolling it over, drawing the pattern and ramming, the mold was completed in 46 minutes, as compared with nine hours when made by hand. The actual ramming time, however, was 32 seconds and the mold was jarred 45 times.

The method employed for ramming molds on the Herman machine consists of an upward and downward movement of the table plate, which strikes upon a resilient surface located in the base. This causes the sand to be packed uniformly over the pattern, thereby preventing scabs and swells. The table plate is provided with 20 jarring bosses, 5½ inches in diameter, which strike upon the same number of discs located upon the upper side of the base of the machine which is of heavy cast iron construction, weighs about eight tons and is reinforced with cross section ribs extending its entire height.

On top of each of these ribs are openings 5 inches square in which are placed a set of steel discs to correspond with the jarring bosses on the table plate. The machine is operated by compressed air, which passes through a 9-inch valve and raises the table plate 2½ inches. A tripper on the table plate when it has reached this height in its upward travel reverses the valve, instantly expelling the air and permitting the table plate to drop. The operator can absolutely control the number of strokes required for ramming the mold.

The cylinder is 28 inches in diameter and has a lifting capacity of 14 tons with 80 pounds of air. There are 16 guides on the outer edge of the table plate, which, with the long bearing of the plunger, afford ample means to steady it while the machine is in operation. The 20 jarring discs are equally distributed under the table plate, the outer disc being placed within 6 inches of the edge, thereby eliminating any vibration which might be caused by the use of one disc located at the center of the machine or around the cylinder. Immediately following the demonstration, orders for two machines of a similar size were placed with the Herman Pneumatic Machine Co. Charles Herman, originator of

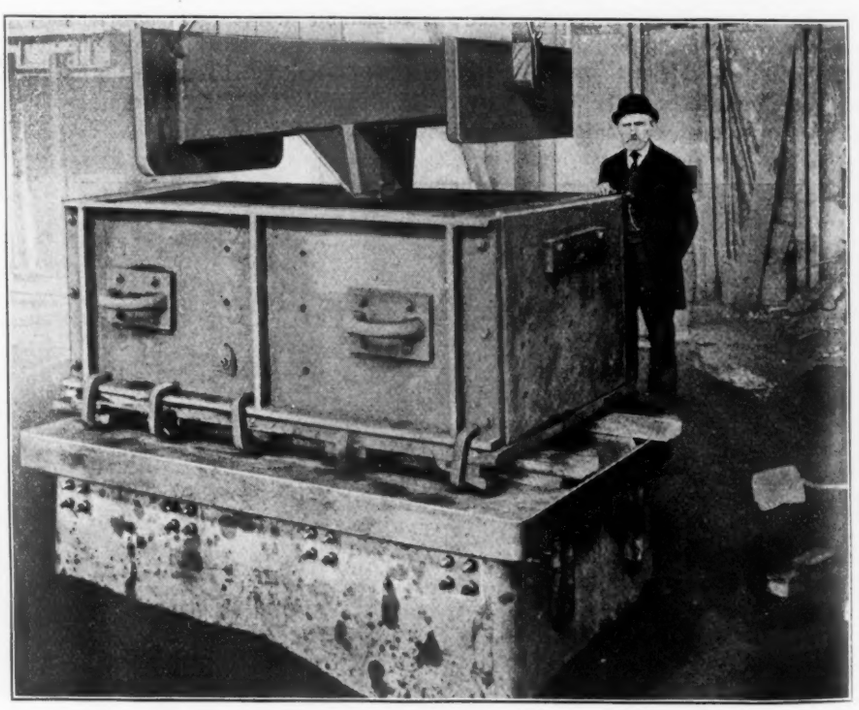


FIG. 2—FLASK ON HERMAN JARRING MACHINE. WEIGHT, FILLED WITH SAND, 3½ TONS. SIZE, 3 FEET 6 INCHES x 4 FEET x 8 FEET

the jarring principle of ramming molds, and vice president of the Herman Pneumatic Machine Co., is shown at the side of the machine in Fig. 2.

The amount of work that can be produced by a machine of this type is practically unlimited. It is largely governed, however, by the equipment of the foundry for handling sand and flasks expeditiously, and sand conveyors for filling the flasks should be used in order that no delay is encountered in ramming the molds. Where the amount of large work is insufficient for a machine of this size, several smaller flasks containing molds up to its capacity may be rammed at the same time. Jarring machines of smaller sizes made by this concern are provided with lifting, roll-over and pattern drawing devices. These machines are built with table plates of the following sizes: 24 x 30, 35 x 38, 40 x 50, and 60 x 60 inches. If it is not desired to use the roll-over attachment, the machine so equipped can be used for jarring purposes only.

PAXSON-DEEMER SIDE BLOW CONVERTER.

The Paxson-Deemer side blow converter for the manufacture of steel for casting purposes embodies a number of practical features whereby the charge is decarbonized in a shorter time than in the ordinary side blow converter, effecting a considerable saving of metal which would otherwise be burned out when the conversion process is prolonged. As shown in Figs. 1 and 3, the vessel is of a different form than generally designed and permits of the introduction of the blast through an increased number of tuyeres over a large area of the bath. As shown in Fig. 1, the blast strikes the metal partly above and partly below the surface, blowing it to the opposite side of the converter, thus agitating the bath and circulating the metal very rapidly, resulting in the oxidation of the silicon, which produces a high temperature and removes the impurities in a very short time.

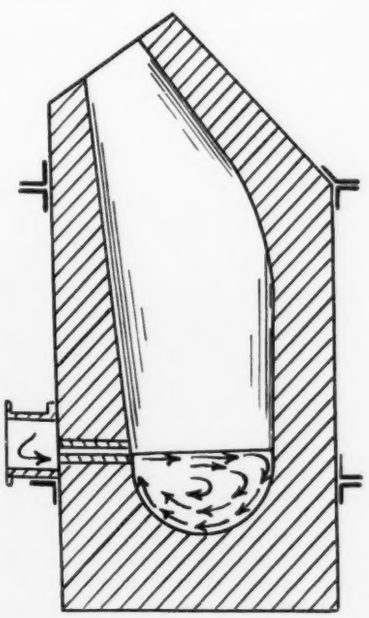


FIG. 1—PAXSON-DEEMER CONVERTER. ARROWS SHOW HOW THE METAL IS FORCED TO THE OPPOSITE SIDE OF THE VESSEL BY THE BLAST

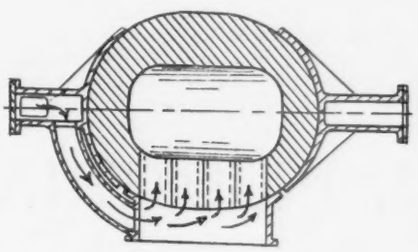


FIG. 2—PLAN VIEW OF CONVERTER SHOWING TUYERE ARRANGEMENT

A plan view of the converter showing the wind box and tuyeres is shown in Fig. 2. The shell is built of heavy steel plates and the wind box, trunnions, housings, and all other parts are made of steel castings. As the converter is made in only one size for the production of four-ton heats, its capacity can be reduced for smaller charges by increasing the thickness of the lining.

The converter is built by the J. W. Paxson Co., Philadelphia, who will design, erect and equip a complete steel casting plant, if desired, under the supervision of Selden S. Deemer, who has had more than 20 years' experience in the manufacture of steel castings.

On Feb. 1, Hickman, Williams & Co., Chicago, producers and merchants of pig iron and coke, will establish offices in New York, Philadelphia and Boston, with eastern headquarters in the Terminal building, 30 Church street, New York City. The offices of N. S. Bartlett & Co., 126 State street, Boston, and those located in the Harrison building, Philadelphia, will be occupied by Hickman, Williams & Co., after the date noted above. The eastern offices will be under the direction of J. O. Henshaw, who will retire as a partner of the firm of N. S. Bartlett & Co., and at the same time will become a member of the firm of Hickman, Williams & Co. As far as possible the entire organization of N. S. Bartlett & Co. will be retained. In addition to the various brands of pig iron, alloys and coke, for which Hickman, Williams & Co. are now selling agents, this concern will continue to handle all of the brands of iron, coke, etc., that N. S. Bartlett & Co. have sold in the past.

TRADE PUBLICATIONS.

SHOP HEATING.—An extensive treatise containing many practical suggestions on shop heating, written by F. R. Still, has just been published in booklet form by the American Blower Co., Detroit. It contains many practical hints relative to the heating of foundries and machine shops by the blower system. This concern is also sending out considerable literature, including a pamphlet describing forge blowers, a catalog devoted to steam traps of the tilting tank type, as well as an eight-page bulletin describing variable speed steam engines, vertical valve oiling engines, disc ventilating fans and a typical installation of the heating and ventilating apparatus made by this concern.

OIL BURNING APPLIANCES.—The Hauck Mfg. Co., Brooklyn, N. Y., has put out an illustrated 8-page bulletin, series 27, describing its portable oil burners designed for skin drying molds, heating ladles, burning-on castings, firing-up cupolas, brazing, etc. The apparatus is illustrated in detail and some interesting data are given.

WIRE BRUSHES.—The American Wire Brush Co., 277 Greenwich street, New York, has recently brought out a variety of literature, illustrating and describing its brushes in which the wires are fastened by a novel and patented method. A particularly complete line is made for use in foundries, forge and machine shops.

TURBINE BLOWERS.—The D'Olier Engineering Co., Philadelphia, Pa., has issued two bulletins, one devoted to a description of steam turbines for direct and belt connected service for operating pumps, blowers and generators. Bulletin No. 9 describes horizontal centrifugal pumps of various types.

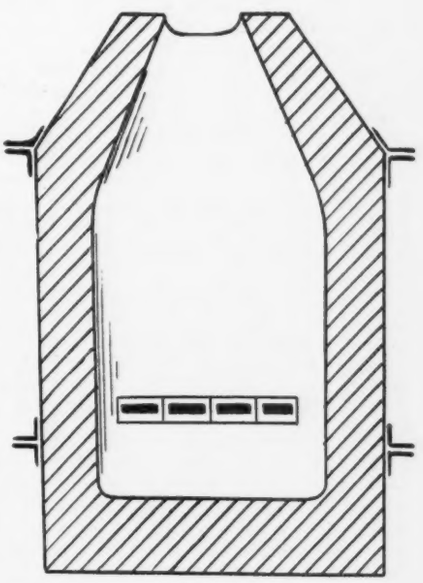


FIG. 3—CROSS SECTION OF PAXSON-DEEMER CONVERTER, SHOWING TUYERE ARRANGEMENT

FOUNDRY EQUIPMENT.—The Northern Engineering Works, Detroit, in booklet No.

93, briefly refers to its extensive line of foundry machinery and equipment. The matter is presented in condensed form, well illustrated, and is merely intended as a reminder to the foundryman considering improvements and extensions.

MULTIPLE MOLDING.—The Rathbone Molding Machine Co., Detroit, in a 32-page catalog outlines some of the many advantages of multiple molding and describes the Rathbone multiple molding machine and its method of operation. The catalog is handsomely illustrated and contains many views of intricate patterns which are successfully molded on this machine, and molds are also shown stacked for casting purposes. Some of the advantages claimed for the multiple molding process include a reduction of labor, minimum handling of sand, smaller number of flasks required, increased output per square foot of floor space, reduction in pouring labor, less weighting and clamping, and no rolling over of the molds is required.

MOLDING MACHINES.—The J. W. Paxson Co., Philadelphia, in bulletin No. 19 describes and illustrates its line of molding machines. These include a rock-over, in which the flask and mold drop away from the pattern, as well as a Glenwood rock-over machine. An interesting application of P. H. pneumatic squeezer rock-over machines, all on the same bed plate, is also shown. Another machine intended primarily for brass foundry use is equipped with a revolving head and pneumatic rammer. A double arm hand squeezer equipped with a knee-pad, vibrator, aluminum pattern plate, etc., is also shown, as well as pipe molding machines of various designs. An interesting rotary molding machine is described which accomplishes in one movement the ramming, rolling over and stripping of the pattern. A small hand squeezer for brass foundries is also illustrated. Another pamphlet issued by the J. W. Paxson Co. describes a combined molding bench and ladle carriage, which saves labor and prevents accidents in pouring, and furthermore effects great economies in molding space.

GENERAL INDUSTRIAL NOTES

The Auburn Foundry Co., Auburn, Ind., is erecting a new plant which will consist of a foundry, 52 x 75 feet, cupola and grinding rooms, 25 x 52 feet, and a pattern shop, 25 x 30 feet. The tumbling mills will be located in a department of the foundry, 12 x 18 feet. Gray iron castings will be made and equipment will also be installed for producing brass castings.

The Sayre Iron Works, Inc., Phoebus, Va., is building a concrete foundry, 70 x 200 feet, which will be completed in about two months. This concern succeeds Sayre Bros., Inc., whose plant was destroyed by fire last year.

The Cedarburg Foundry Co., Cedarburg, Wis., has awarded contracts for rebuilding its plant recently destroyed by fire. The new structure will be 60 x 85 feet, of cement block construction, and will be ready for occupancy early in February.

A new foundry is being erected at Green Bay, Wis., by Joseph Rothe. The building will be of concrete construction, 80 x 120 feet.

The Sioux City Foundry & Mfg. Co., Sioux City, Iowa, has commenced the erection of a foundry, boiler and machine shops. The foundry will be 75 x 100 feet.

The Duncan Foundry & Machine Co., Peoria, Ill., is erecting a new foundry, 120 x 160 feet.

The American Car & Foundry Co. has been considering the erection of a Canadian plant. Several sites have been offered at Hamilton, Ont.

The Johnson Traction Engine Co. has purchased a 9-acre site near Sunnyvale, Cal., where it will construct a new plant. The machine shop will be 60 x 250 feet and the foundry, 60 x 280 feet. The expenditure for the buildings and equipment is estimated at about $40,000.

Boyd & Co., Huntingdon, Quebec, will add a foundry for the production of castings for its line of hay presses, threshing machines, etc.

The Canada Foundry Co., Ft. William, Ont., Can., will build an addition to its plant at a cost of $17,000.

The Garrie-Brook Mfg. Co., Pembroke, Ont., Can., will erect a foundry for the manufacture of gray and malleable iron castings.

The Syracuse Die Molded Casting Co., Syracuse, N. Y., has been incorporated with $10,000 capital, to engage in the manufacture of castings from die molds, which will subsequently require no finishing. This concern has leased a portion of the factory building at 303 Wallace street, and at the present will confine itself to producing difficult parts of machines made of aluminum and other alloys equal in strength to ordinary brass castings. O. M. Gale is president and treasurer; O. E. Stowell, vice president and J. H. Johnston, secretary.

George W. Thomas and William G. Bridges have purchased a site at Johnstown, Pa., and propose to erect a foundry in the near future.

A brass foundry will be erected by the Hewitt Mfg. Co., Houston, Tex., 85 x 150 feet in size.

The E. R. Thomas Motor Co., Buffalo, has awarded contracts for extensions to its foundry.

Oman & Johnson, Wilmar, Minn., will erect a new foundry which will be operated in connection with their machine shop. G. Erickson, who has had a wide experience in foundry work, principally at Moline, Ill., will have charge of the new plant.

The New Process Steel Co., Marshall, Mich., is erecting an addition to its foundry, 25 x 110 feet. A machine department has also been installed and this concern is now in position to furnish steel crank shafts and connecting rods in the rough as well as finished. The company has been reorganized by the election of the following officers: S. C. French, president; F. A. Stewart, vice president, and H. L. Chapman, secretary and treasurer.

The T. H. Symington Co., Baltimore, Md., has secured an option on a 20-acre site at Rochester, N. Y., and has decided to erect a large plant for the manufacture of malleable iron journal boxes for freight and passenger cars, ball bearing center plates and miscellaneous railroad malleable castings. The new plant will consist of several buildings, which will include a large machine shop, foundry and power plant. Most of the equipment of the plant in Corning, N. Y., will be moved to Rochester, but on account of the large increase in capacity of the new works, considerable new machinery will be required. To cover the construction of the new plant without drawing on the working capital, the company will issue bonds to the amount of $650,000. Thomas H. Symington is president and A. H. Weston, mechanical engineer.

The Hart-Parr Gasoline Engine Co., Charles City, Iowa, will erect a foundry for the manufacture of castings for its line of engines.

The Ames Iron Works, Oswego, N. Y., is contemplating the erection of a new plant which will include buildings for the manufacture of boilers covering a space about 200 x 400 feet. The foundry will be removed to the present boiler shop which is 100 x 400 feet.

The Crane-Best Co., Chicago, has awarded contract to H. L. Kreusler & Co., Pittsburg, for the erection at Verona, Pa., of a foundry, 175 x 323 feet, machine shop, 129 x 368 feet, and shipping room, 64 x 129 feet. The buildings will be of steel, brick and reinforced concrete construction.

The A. P. Smith Mfg. Co., Newark, N. J., shortly expects to begin work on the construction of its new plant for the manufacture of tapping machines, valves and general water work supplies. It will be built at East Orange, N. J., adjoining the works of the Sprague Electric Co. The main building will be 50 x 215 feet, of reinforced concrete construction and the plant will also include a pattern storage building, 45 x 90 feet, power house, 40 x 60 feet, foundry, 50 x 100 feet and machine shop, 100 x 155 feet.

The Turner & Seymour Co., Torrington, Conn., will erect a foundry 50 x 100 feet.

Mitchell & Van Meter, Pottstown, Pa., are having plans prepared for a brass foundry 40 x 75 feet.

The Shull Steel Casting & Mfg. Co., Canton, O., is building a large pattern storage vault.

The Talladega Foundry & Machine Co., Talladega, Ala., will erect a machine shop and foundry. The officers of the company are E. W. McDonald, president; C. L. Kelly, vice president; J. M. Thomas, treasurer, and C. F. Baker, secretary.

The Maysville Foundry & Engineering Co., Maysville, Ky., successor of the Maysville Foundry, Machine & Marine Co., is adding a 40-foot extension to its foundry and is also erecting a side bay, 55 x 110 feet. New equipment that will be installed includes a 42-inch cupola, blower, air compressor, pneumatic chippers, tumbling mills, etc.

At the annual meeting of the Tappin-Rice-Clerkin Co., Akron, O., it was decided to erect a large addition to the foundry operated by this concern.

The Eberman-Bailey Brass Works has been organized at Jamestown, N. Y., to engage in the manufacture of brass castings, and a foundry will shortly be erected. H. J. Eberman and J. A. Bailey, formerly of the Art Metal Co., of Jamestown, comprise the new concern.

The Fairfield Aluminum Co., Fairfield, Conn., manufacturer of high grade aluminum castings, has built an addition to its foundry and is installing 12 melting furnaces.

The Bessemer Soil Pipe Co., Bessemer, Ala., will shortly erect an extension to its plant which will provide room for 14 new floors for making pipe from 2 to 6 inches in diameter. Another cupola will be added.

The foundry department of the Frank Gruber Boiler & Machine Works, Fort Wayne, Ind., has been leased by Joseph Steib, who assumed the lease upon the retirement of W. E. Herdin. An addition to the present buildings, 60 x 100 feet, will be made, and the foundry will be located on the north end of the property, occupying a space 60 x 70 feet. A new cupola will also be installed.

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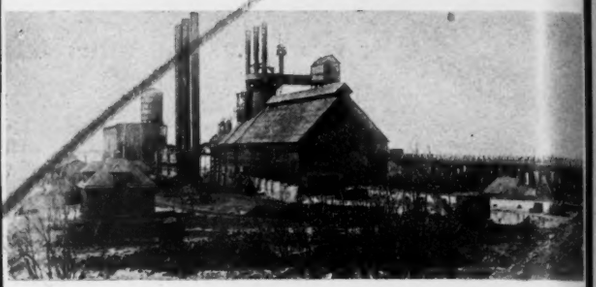

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